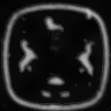


A Guide to the Coastal Western Hemlock Zone, Northern Drier Maritime Subzone (CWHf), in the Prince Rupert Forest Region, British Columbia

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A Guide to the Coastal Western Hemlock Zone, Northern Drier Maritime Subzone (CWHf), in the Prince Rupert Forest Region, British Columbia

by

S. Haeussler¹, J. Pojar¹, B.M. Geisler¹, D. Yole¹, and R.M. Annas²

¹British Columbia
Ministry of Forests
Research Section
Prince Rupert Forest Region
Bag 5000
Smithers, B.C.
V0J 2N0

²British Columbia
Ministry of Forests
Research Branch
Victoria, B.C.



Province of British Columbia
Ministry of Forests

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1 INTRODUCTION

The British Columbia Ministry of Forests is currently developing an ecosystem classification of the forest and range land of the province. Our classification is based, with some modifications, on the biogeoclimatic system developed over the past thirty years by Dr. V.J. Krajina and his students at the University of British Columbia. The system incorporates primarily climate, soil, and vegetation data. The resulting biogeoclimatic classification provides a framework for forest and range management, as well as for scientific research.

This guide briefly outlines the principles and methods of the classification system, stressing the two primary areas of emphasis within the classification, the biogeoclimatic (zones, subzones, variants), and the ecosystematic (ecosystem associations and their phases and variations). We summarize the environmental characteristics of the Northern drier maritime subzone of the Coastal Western Hemlock Zone (CWHf) and two of its variants, a lower (CWHf1) and a higher elevation (CWHf2) variant. The classification of the subzone at the ecosystematic level is then presented in detail.

An ecological classification can serve several purposes, depending on the needs and viewpoints of the users of the classification. The B.C. Ministry of Forests intends its classification to provide a framework for scientific research and resource management, to be used as a tool by scientists and resource managers responsible for maintaining or enhancing supplies of timber, forage, wildlife habitat, recreation, and water quantity and quality. All resources can be related to our ecosystem classification, but timber has priority within this ministry. Because of this priority and also because of insufficient knowledge of other resources, we have developed primarily silvicultural interpretations, which are presented in the final section of the report. Use these prescriptions as a guide: they are not intended to be final or to be used in "cookbook" fashion. With time and increasing knowledge, we will amplify and modify the interpretations as required.

The area covered by this guide encompasses most of the lowland and mid-elevation forests of the central part (centred on Terrace) of the Kalum

Timber Supply Area (T.S.A.), and some of the middle elevations of the westernmost Kispiox T.S.A. (see Figs. 1 and 5). Originally the study was to cover the now obsolete Skeena Public Sustained Yield Unit, but we extended the boundaries both to the north and the south.

We have included, in the pocket on the inside back cover, a map at 1:500 000 of the CWHf in the Prince Rupert Forest Region. Ultimately a map of all biogeoclimatic zones, subzones, and variants will be produced at a scale of 1:500 000 for the area covered by this report. The map will be similar to that produced by Klinka et al. (1979, "Biogeoclimatic Units of Central and Southern Vancouver Island"). Unfortunately we do not yet know enough of the study area (map sheets 93 NW and 103 NE), especially at higher elevations, to make such a detailed map.

"A Guide to Some Common Plants of the Skeena Area, British Columbia" has been prepared (Coupé et al. 1982), and is designed to be used in conjunction with this guide to classification and interpretation. We have also produced a companion report entitled "A Guide to the Interior Cedar - Hemlock Zone, Northwestern Transitional Subzone (ICHg) in the Prince Rupert Forest Region, British Columbia"¹. The ICHg guide is organized along the same lines as the CWHf guide, as both have evolved from the same original research project.

¹ S. Haeussler, J. Pojar, B.M. Geisler, D. Yole and R.M. Annas. 1983. A guide to the Interior Cedar-Hemlock Zone, northwestern transitional subzone (ICHg) in the Prince Rupert Forest Region. B.C. Min. For., Smithers, B.C. Unpublished report.



FIGURE 1. Timber Supply Areas of the Prince Rupert Forest Region, British Columbia.

2 OBJECTIVES

The goal of the ecosystem classification program is the improvement of forest management in B.C. The overall objective of the program is to provide resource managers with some of the tools to meet the goal, by developing a "permanent", land-based, ecological classification to organize our knowledge of ecosystems and to serve as a framework within which to manage resources. In other words, the classification program aims to both organize and apply our knowledge of the structure, function, and relationships of forest and range ecosystems.

More specifically, this guide has five objectives:

1. Characterization, description, and mapping of the Coastal Western Hemlock Biogeoclimatic Zone, Northern drier maritime subzone (CWHf), in the Prince Rupert Forest Region;
2. Characterization and description of forest ecosystems in the CWHf;
3. Provision of aids in the identification of biogeoclimatic and ecosystematic units in the CWHf;
4. Development of preliminary silvicultural and forest management interpretations and recommendations relating to the ecosystem units of the CWHf;
5. Promotion of the concept of the ecosystem as the fundamental unit of forest management.

3 PRINCIPLES AND PHILOSOPHY

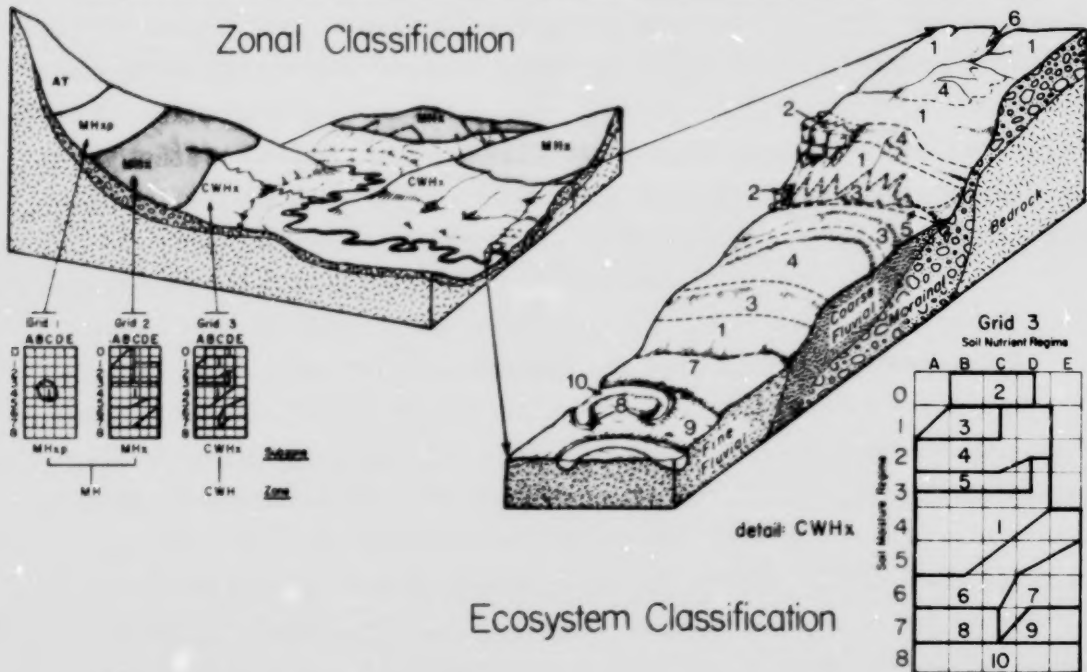
Numerous authors working in many different scientific fields have analysed and described the philosophy and methods of taxonomic classification. Some summaries pertinent to ecosystem classification are by Cline (1949), Whittaker (1962), Sokal (1974), Soil Survey Staff (1975), Bailey et al. (1978), Davis and Henderson (1978), and Pfister and Arno (1980). The biogeoclimatic system used by the Ministry of Forests is a classification of ecosystems (also called biogeocoenoses). It is being developed as a multi-level hierarchy with two primary sections or areas of emphasis: ecosystem or biogeocoenotic levels of integration, and biogeoclimatic or zonal levels (Fig. 2). Each section has several hierarchical taxonomic categories, as explained below in Sections 3.4 and 3.5.

3.1 Ecosystem

Ecosystem is the term used for the sum total of vegetation, animals, and physical environment in whatever size segment of the world is chosen for study (Fosberg 1967). Ecosystems are interacting complexes of living organisms (plants, fungi, bacteria, animals) and the physical environment (soil, air, water, bedrock) immediately affecting them. The ecosystem, as defined by Tansley (1935), has long served as the fundamental conceptual and functional unit of ecology. However, Tansley's concept of ecosystem is too broad to easily integrate into a formal classification. Therefore, Krajina (1960) proposed that Sukachev's biogeocoenose (Sukachev and Dylis 1964) for practical purposes best represents a basic ecosystem. A biogeocoenose is a special case of the ecosystem, but the two terms are used here interchangeably. Hence, for our purposes a terrestrial ecosystem (biogeocoenose) is a unit or portion of the landscape and the life on and in it. It is a landscape segment relatively uniform in the composition, structure, and properties of both the biotic and abiotic environments and in their interactions.

Numerous organisms such as fungi, earthworms, bacteria, insects, birds, and mammals are as much a part of the forest ecosystem as are trees, shrubs, herbs, and mosses. Furthermore, within the ecosystem

Schematic Relations between Zonal and Ecosystem Classifications



there is a complex and dynamic set of relationships among these organisms and between them and their physical environment. However, for simplicity the classification system deals primarily with two components of the ecosystem: vegetation and soil. The model of ecosystem function is that of Major (1951): Vegetation and soils are products of climate, organisms, topography, parent material, and time. Plants and soil, considered simultaneously, integrate all ecosystem components and reflect ecosystem functioning. They are easy to observe and assess, and are considered to be the most convenient and suitable ecosystem features upon which to base the classification.

Thus, an ecosystem may be practically characterized by a "plant community" (an area of relatively uniform vegetation) and the "soil polypelon" (an area, to the depth of the solum, of relatively uniform soil) upon which the plant community occurs. An ecosystem has geographical bounds; its size is determined by the extent of the plant community and the associated soil polypelon. The lateral boundaries may be abrupt, but more commonly they are gradual. As a result, an individual ecosystem usually contains some variation in biotic and abiotic characteristics.

3.2 Zonal Ecosystem

Climate is the fundamental determinant of the nature of terrestrial ecosystems. A classification of ecosystems should attempt to group related ecosystems influenced by the same mesoclimate. However, climate data are scant or lacking in some areas and climatic analysis alone will not produce an ecosystem classification. A reliable functional link between climate and ecosystems is needed. The concept of the zonal or climatic climax ecosystem provides this link.

The zonal ecosystem is that which best reflects the mesoclimate or regional climate of an area. The integrated influence of climate on the vegetation, soil, and other ecosystem components is most strongly expressed in those ecosystems least influenced by local relief or by

physical and chemical properties of soil parent materials. Such ecosystems generally occur on gentle to moderate (5-30%) slopes, in positions that neither receive nor shed an excess of water and nutrients. They have normal exposure to solar energy (heat and light) and wind, and are not affected by localized cold air drainage. Zonal ecosystems have intermediate soil textures (broadly loamy), medium or mesic moisture regimes, and medium or mesotrophic nutrient regimes¹. Soils usually are moderately pervious, deep (greater than 1 m), and without root-restricting layers within approximately 1 m of the surface. Hence, the biogeochemical cycles and energy exchange pathways of zonal ecosystems are more or less independent of local relief and soil parent material, and are in equilibrium with the regional climate.

Other ecosystems in a given area are influenced more strongly by local physiography and the physical and chemical properties of soil parent materials. They may be drier, wetter, richer, or poorer than zonal ecosystems, and they do not provide as clear a reflection of the regional climate.

Zonal ecosystems are characteristic of the regional climate that dominates their development. Hence, they are used to characterize biogeoclimatic units, which represent broad geographical areas of similar mesoclimate. The distribution of zonal ecosystems also determines the geographical extent of the biogeoclimatic units. Thus the concept of the zonal ecosystem links the ecosystematic and biogeoclimatic levels of classification (a zonal ecosystem labelled as "1", is indicated in Fig. 2).

¹ Mesic and mesotrophic are qualitative, relative terms that represent different actual conditions in different zones (e.g., a mesic ecosystem in the Coastal Western Hemlock Zone is quantitatively wetter than a mesic ecosystem in the Sub-Boreal Spruce Zone). However, in all zones mesic and mesotrophic designate "average" or medium moisture and nutrient conditions, intermediate between the existing extremes of each zone.

3.3 Climax and Succession

3.3.1 Climax

The term "climax" in ecology refers to a condition of dynamic equilibrium, a steady state rather than a static endpoint. A climax ecosystem is, in theory, a stable, permanent occupant of the landscape, self-perpetuating unless disturbed by outside forces or modifying factors. The living components of a climax ecosystem are in equilibrium with the prevailing factors of the physical environment and the member species are in dynamic balance with one another.

In climax vegetation the species of plants are self-perpetuating. Tree species of a climax forest are present as seedlings, saplings, and subcanopy and canopy trees. Similarly, climax shrubs, herbs, mosses, liverworts, and lichens are present in all stages from seedling or sporeling to maturity. In zonal forest ecosystems, only tree species that tolerate shade and intermediate moisture and nutrient conditions regenerate continually under the forest canopy.

3.3.2 Types of climax

Climatic climax ecosystems reflect the development potential of the prevailing regional climate. Other types of climax ecosystems occur where certain environmental factors have a greater influence on ecosystem development than does the regional climate. An edaphic climax differs from the climatic climax due to extreme soil or substrate conditions such as very coarse texture, high base saturation, or poor drainage. A topographic climax reflects compensating effects of topography on local climate (e.g., such as occur on a steep south slope). A topoedaphic climax occurs as a result of the combined influence of soil and topography (e.g., shallow, stony soil on a steep south slope). A fire climax may result from recurrent wildfire.

3.3.3 Succession

Ecosystems arrive at climax through a process of change called ecological succession, the progressive development of ecosystems through time. Sequential series of successional stages are called seres. There are several recognizable seral or successional stages in ecosystem development from, for example, an original bare surface to a mature forest. In theory, succession ends in a mature, climax ecosystem.

3.3.4 Potential climax and succession

British Columbia foresters will increasingly deal with seral ecosystems in the future, as older climax or near-climax stands are logged and replaced with young seral stands. Many of our management interpretations and recommendations are based on the expectation that if a disturbed (logged) forest is left alone it will gradually return to its natural state according to traditional successional theory. Whether this actually happens or not is uncertain, but nevertheless is largely an academic question because industrial forestry will maintain most productive ecosystems in seral states, probably less than 100 years old. Because our system classifies potential climax ecosystems, the classification will not become obsolete when managed seral forests prevail, if logging-related disturbance is not excessive. The potential and limitations of a logged-over site remain similar to what was set out by the classification and interpretation of the original or potential climax ecosystem. The ecosystem remains in the clearcut, although in much altered form. Identification of a seral ecosystem must be based on physical and edaphic site characteristics as well as vegetation, because the quantity and vigour of indicator species is related to crown closure as well as to moisture and nutrient regime. However, successional trends toward the climax can usually be identified even in young stands. We can still recognize, describe, and integrate the seral ecosystem into our classification,

and can still make interpretations and predictions about the seral ecosystem throughout its succession towards harvestable age. Ecosystem classification thus provides a more or less permanent and ecologically based system of land classification, with immediate and continuing application to management activities. In this report, we have treated the few seral stages that we studied as ecosystem variations. With sufficient study, successional stages and pathways (which depend on stand history) could be described within each ecosystem unit, much as Arno (1982) has done within habitat types in western Montana. If more detail on seral ecosystems was required, a parallel classification, resulting in an array of seral ecosystem associations, could also be constructed.

3.4 Ecosystem Levels of Classification

Classification at ecosystematic (or biogeocoenotic) levels involves small areas relatively homogeneous in vegetation, soils, and implicitly in patterns of nutrient and energy dynamics, whereas classification at biogeoclimatic levels involves broad geographical areas of similar climate.

In this report, we use the ecosystematic categories of ecosystem association and type. Phases and variations of ecosystem associations are also recognized and used although the phase and the variation are not formal categories in the classification. We will go into some detail in defining ecosystematic units, as they represent the levels of the classification within which most of the users of this report will be working.

3.4.1 Ecosystem type

An individual ecosystem consists of a plant community plus the soil polypedon upon which the community occurs. In the Coastal Western Hemlock Zone (CWH), the landscape is covered by numerous ecosystems of varying size, spread out over hill and valley. Most are forested; some are grassy, brushy, boggy, or have been recently

cut or burned. Often the different ecosystems form a complex mosaic over the land, but their distribution is not random or helter-skelter. Similar plant communities recur in similar habitats, as do similar soil polypedons. The classification groups similar plant communities into "plant associations", and similar soil polypedons (in terms of humus form, horizons, texture, reaction (pH), parent materials, rooting depth, and coarse fragments) into "soil families". We define an "ecosystem type" as all ecosystems (land areas plus their biota) capable of producing vegetation belonging to the same climax plant association on soil of a single soil family.

3.4.2 Ecosystem association

We then define the "ecosystem association" as all ecosystems capable of producing vegetation belonging to the same plant association at climax. Thus an ecosystem association is a group of related ecosystems physically and biologically similar enough that they have or would have similar vegetation at climax. The ecosystem association is similar to the habitat type of Daubenmire (1968) and Pfister et al. (1977).

We use the climax (or, where necessary, the advanced seral) condition to characterize ecosystem associations because we think that, as the culmination of ecological succession, the climax association best reflects the integration of environmental factors. One ecosystem association may include a variety of disturbance-induced, or seral, ecosystems, but succession will ultimately result in similar plant communities at climax throughout the association. Use of the climax plant association to name ecosystem associations does not imply that climax vegetation dominates the present landscape. Although the subzone is still dominated by old-growth, climax forest, many ecosystems in the CWHf reflect some form of disturbance and are in various stages of succession towards climax.

Thus, at this level of the classification we use the vegetation to define the taxon of ecosystem association. Although such an approach risks over-simplification, its utility validates it to some extent, as vegetation may be readily observed and described. Furthermore, plants integrate and reflect all other ecosystematic factors (climate, nutrient and water levels, time, etc.), indicating that vegetation is a product as well as a part of the environment.

For these reasons, and for brevity and familiarity, we label the ecosystem association with the name of the climax plant association. For example, in the CWHf1 there is, the Picea sitchensis x glauca¹ - Tsuga heterophylla - (Thuja plicata) - Lysichiton americanum ecosystem association or, colloquially, skunk cabbage (represented by area 8 in Fig. 2). Ideally, the name for this ecosystem unit would incorporate features of physiography and soils, but that would be impractical. However, a reference to the skunk cabbage ecosystem association signifies that group of swampy ecosystems: 1) that occur at the base of slopes or in depressional areas, over poorly drained fluvial, morainal, or lacustrine parent materials; 2) that have developed Organic soils or Gleysols, and Histomoder or Hydromoder humus forms²; 3) that have an excess of soil water and medium to good nutrient supply but poor soil aeration; and 4) that at climax develop vegetation that may be characterized by the Picea - Tsuga - (Thuja) - Lysichiton plant association. Providing the classification is adequately described, explained, and understood, a relatively simple name can convey a great deal of useful information about individual ecosystems in the field.

¹ See page 143 for source of botanical nomenclature.

² Humus form (forest floor) terminology by Klinka et al. (1981).

3.4.3 Ecosystem association phase

Sometimes the ecosystem association, which is a fundamental theoretical unit in the classification, may also be the operational unit upon which to base silvicultural and other management decisions. However, in many cases the ecosystem association must be subdivided into more operationally significant units. This is especially true of those widespread ecosystem associations that encompass quite a range of habitat conditions.

The "ecosystem association phase" (or "ecosystem phase" for short) is used for better site differentiation and identification. The ecosystem phase is basically a functional subdivision of the ecosystem association and recognizes some edaphic property or attribute that may be useful or significant to the users of the classification. We have not yet used the ecosystem phase in the classification of the CWHf, but it would, for example, be useful to recognize two general particle size classes (coarse and fine) as two phases of the CWHf1/01, or Zonal hemlock - Vaccinium - moss ecosystem association, and it would give more meaning to silvicultural interpretations of this widespread unit. Other ecosystem phases might be based on slope classes, aspect, soil climate, bedrock type, or some other useful feature of the soil or landform. The ecosystem phase thus reflects variation contained within ecosystem associations (and subassociations), and allows differentiation of recognizable and repeatable subunits of the ecosystem association for management, silvicultural, or purely descriptive purposes.

3.4.4 Ecosystem association variation

We use the "ecosystem association variation" (or "ecosystem variation" for short) to accommodate slight vegetative deviations from the central concept of the ecosystem association, or to describe widespread successional stages of the climax association.

In part because our classification relies on climax ecosystems, this type of variability does not yet have a place in the formal classification. However, it is important to recognize and describe such variation in species composition, since it aids in the identification and interpretation of ecosystems in the field.

The Moss variation of the CWHf1/01 is an example of a vegetative deviation from the central concept of the ecosystem association. The Moss variation is more or less identical to typical CWHf1/01, except for a lack of the characteristic, well-developed, Vaccinium - dominated shrub layer.

Seral ecosystems are common in the CWHf. They include fire-originated seral stands of pine and/or aspen and paper birch that appear to belong to drier ecosystem associations such as the CWHf1/02. Floodplain cottonwood stands are recognized as a seral variation of the CWHf1/05 or Fluvial spruce - devil's club - fern. Seral variations of all other CWHf associations also exist, but we have scarcely sampled them. While this treatment of seral ecosystems is unsatisfactory, for now it is sufficient.

3.5 Biogeoclimatic Levels of Classification

The biogeoclimatic area of emphasis provides higher categories in the taxonomic hierarchy to accommodate further generalization of ecosystem units, based mainly on climatic relationships. Classification, characterization, and mapping of biogeoclimatic units are the major activities carried out at these levels. Biogeoclimatic units or categories commonly used by the Ministry of Forests are the zone, subzone, and variant. In addition, phases are recognized and used, but the phase is not a formal category in the classification.

3.5.1 Biogeoclimatic subzone

A distinct climatic climax or zonal ecosystem association characterizes a "subzone". A subzone thus consists of unique sequences of geographically related ecosystems in which climatic

climax ecosystems are members of the same zonal ecosystem association. Such sequences are influenced by one type of regional climate. Subzones are the basic units of biogeoclimatic classification, and are the first to be recognized in the classification process. Note that the two sections of the classification are linked through the fundamental relationship between the zonal ecosystem association and the subzone.

This report deals primarily with one subzone of the Coastal Western Hemlock Zone, the CWHf or Northern drier maritime subzone.

3.5.2 Biogeoclimatic variant

Subzones also contain considerable variation, for which we have provided the biogeoclimatic category of "variant". Variants reflect further differences in regional climate, and are generally recognized for areas that are drier, wetter, snowier, warmer, or colder than other areas in the subzone. These climatic differences result in corresponding differences in vegetation, soil, and ecosystem productivity. The differences in vegetation may be expressed as changes in the proportion and vigour of certain plant species, or differences in successional development or in the overall pattern of vegetation over the landscape. Differences in soils may be confined to the variation in intensity of certain soil-forming processes and not be markedly expressed in morphological features. Thus, variants are characterized by a distinct zonal ecosystem association plus a supplementary combination of environmental factors.

In this report on the Northern drier maritime subzone, we have recognized two distinct biogeoclimatic variants, the low elevation variant and the high elevation variant, designated CWHf1 and CWHf2, respectively. Characteristic features of and differences between the variants are described in detail in Section 6 of this report.

3.5.3 Biogeoclimatic phase

The "biogeoclimatic phase" accommodates variation, resulting from local relief, in the regional climate of subzones and variants. Phases are useful in designating significant, extensive areas of ecosystems that are, for topographic or topoedaphic reasons, atypical for the regional climate. Examples might be extensive areas of grassland occurring only on steep, south slopes in an otherwise forested subzone; enclaves of apparently coastal forest on moist, northeastern slopes in an interior, continental subzone; or valley-bottom, frost-pocket areas in mountainous terrain. The biogeoclimatic phase relates to local climate and hence is not a formal category in the classification, but phases can be identified and mapped for management or descriptive purposes.

We do not describe any biogeoclimatic phases of the CWHf or either of its two variants in this report. However, areas with atypical local climate certainly do exist within the subzone and may be recognized as special phases when we have more data to describe them.

3.5.4 Biogeoclimatic zone

We group subzones with affinities in climatic characteristics and zonal ecosystems into zones. We define a biogeoclimatic zone as a large geographic area with a broadly homogeneous mesoclimate. Consequently a zone has characteristic webs of energy flow and nutrient cycling, and typical patterns of vegetation and soil. We characterize zones by closely related, zonal ecosystem associations. Zones also have characteristic, prevailing soil-forming processes, and one or more typical, major, climax species of tree, shrub, herb, and/or moss. Zones are usually named by one or more of the dominant shade-tolerant tree species (the Alpine Tundra Zone is a self-explanatory exception) capable of self-regeneration in zonal ecosystems; a geographical modifier is often added to the name.

4 METHODS

Field procedures of the Ministry of Forests' classification program follow those outlined in detail in the manual by Walmsley et al. (1980). Analytic and synthetic methods have been described by Klinka et al. (1977¹, 1979), and are similar to those of Krajina and his students (e.g., Brooke et al. 1970; Wali and Krajina 1973; Kojima and Krajina 1975). However it seems that our methods are still not well understood and need further explanation.

4.1 Plot Sampling

Field sampling is stratified on the basis of biogeoclimatic units and ecological moisture and nutrient regimes. Based on reconnaissance and other available information, tentative biogeoclimatic units are often delineated prior to plot selection. An edatopic grid (Fig. 3) is used as an aid to stratification within each biogeoclimatic unit. We try to sample five or more plots representing each of the possible combinations of moisture and nutrients. Intensity of sampling varies according to the areal extent of the ecosystem, its apparent diversity, and its importance for forestry or range management. Sampling intensity also depends on available access, and on the nature and scale of the project.

We sample selectively. Sample plots are located in habitats that are as uniform as possible; heterogeneous, transitional, or disturbed sites are avoided. To date, most sampling has been confined to climax or near-climax ecosystems. Plots are located so as to represent particular combinations of moisture and nutrients (see Tables 1 and 2). Slope position, indicator plant species, relative tree growth, soil texture, seepage, and base status of parent materials, among other things, are used as clues to moisture and nutrient regimes. The professional judgement of experienced fieldworkers in selecting representative ecosystems is an important part of our approach.

¹ K. Klinka, J.P. Kimmins, J.T. Standish, and S. Phelps. 1977. Initial data synthesis in the synecological classification. B.C. Min. For., Vancouver, B.C. Unpublished manuscript.

ECOLOGICAL NUTRIENT REGIME

ECOLOGICAL MOISTURE REGIME

		OLIGO-TROPHIC	SUBMESO-TROPHIC	MESO-TROPHIC	PERMESO-TROPHIC	SUBEUTROPHIC TO EUTROPHIC
		A	B	C	D	E
VERY XERIC	0					
XERIC	1					
SUBXERIC	2					
SUBMESIC	3					
MESIC	4					
SUBHYGRIC	5					
HYGRIC	6					
SUBHYDRIC	7					

FIGURE 3. Edatopic grid of ecological moisture and nutrient regimes.

The smallest unit of sampling in ecosystem studies is the "sample plot" (also termed "sample plot" by Mueller-Dombois and Ellenberg (1974) for vegetation sampling, and termed "pedon" by Soil Survey Staff (1975) for soil sampling). Plot size in forest stands is usually 400-500 m²; plot shape is variable but usually square or rectangular. At each site, the standardized provincial site, soil, humus form, vegetation, and mensuration data sheets are completed, according to the procedures in Walmsley et al. (1980).

4.2 Analysis

The information collected from the sample plots must be analysed and integrated into a usable classification. To accomplish this we code vegetation and selected soil, physical, and mensurational data for tabulation by a computer program developed by Klinka and Phelps¹. The program sorts, organizes, and presents these data; it does not perform any classification. This procedure aids in the traditional Braun-Blanquet method of classification by tabular analysis (see Mueller-Dombois and Ellenberg 1974), mainly by reducing manual procedures and transcription errors.

The program produces environment, vegetation, and vegetation summary tables. The classifier specifies the tentative ecosystem units, relying to a large extent on personal knowledge and judgement. The program summarizes environment and vegetation data according to the specified units. The summary vegetation table then presents species presence (frequency of occurrence in sample plots) and mean species significance (an estimate of both cover and abundance) for all plant species in all differentiated units. Successive rearrangements can be easily made.

¹ K. Klinka, J.P. Kimmins, J.T. Standish, and S. Phelps. 1977. Initial data synthesis in the synecological classification. B.C. Min. For., Vancouver, B.C. Unpublished manuscript.

TABLE 1. Ecological moisture regime classes¹

DEFINING CHARACTERISTICS			FIELD RECOGNITION CHARACTERISTICS					
Moisture regime	Description	Primary water source	Slope position	Soil properties				
				Texture	Drainage	Depth to impermeable layer	Surface humus depth	Available water stor. cap.
VERY XERIC	Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after ppt.	precipitation						
XERIC	Water removed very rapidly in relation to supply; soil is moist for brief periods following ppt.	precipitation	ridge crests shedding	very coarse (gravelly-s) abundant coarse fragments	very rapid	very shallow (< 0.5 m)	very shallow	extremely low
SUBXERIC	Water removed rapidly in relation to supply; soil is moist for short periods following ppt.	precipitation			rapid			
SUBMESIC	Water removed easily in relation to supply; water available for moderate short periods following ppt.	precipitation	upper slopes shedding	coarse to mod. coarse (LS-SL) mod. coarse fragments	rapid to good	shallow (< 1 m)	shallow	very low
MESIC	Water removed somewhat slowly in relation to supply; soil may remain moist for a significant, but sometimes short period of the year. Available soil moisture reflects climatic inputs.	precipitation in moderately to fine-textured soils and limited seepage in coarse textured soils	mid-slope normal rolling to flat	moderate to fine (L-SiL) few coarse fragments	good to moderately good	moderately deep (1-2 m)	moderately deep	low
SUBHYGRIC	Water removed slowly enough to keep the soil wet for a significant part of the growing season; some temporary seepage and possibly mottling below 20 cm.	precipitation and seepage						moderate
HYGRIC	Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present; possibly weak gleying.	seepage	lower slopes receiving	variable depending on seepage	moderately good to imperfect	deep (> 2 m)	deep	high
SUBHYDRIC	Water removed slowly enough to keep the water table at or near the surface for most of the year; gleyed mineral or organic soils; permanent seepage less than 30 cm below the surface.	seepage or permanent water table			imperfect to poor	variable depending on seepage		variable depending on seepage
HYDRIC	Water removed so slowly that the water table is at or above the soil surface all year; gleyed mineral or organic soils.	permanent water table	depressions receiving	variable depending on seepage	poor to very poor		very deep	
					very poor	variable depending on seepage		variable depending on seepage
								flat

¹ From Walmsley *et al.* (1980).

TABLE 2. Ecological nutrient regime characteristics¹

	Oligotrophic A	Submesotrophic B	Mesotrophic C	Permesotrophic D	Eutrophic E	Hypereutrophic F
Definition	very poor nutritional status, very small supply of available nutrients	poor nutritional status, low supply of available nutrients	medium nutritional status, medium supply of available nutrients	rich nutritional status, plentiful supply of available nutrients	very rich nutritional status, abundant supply of nutrients	saline nutritional status, excess salt accumulations
BEDROCK SOURCE	granite	granodiorite	diorite	gabbro	peridotite	dunite · serpentine
	rhyolite	dacite	andesite	basalt		
	quartzite	quartz gneiss	garnet schist	biotite schist	slate · phyllite	marble
	quartz sandstone	conglomerate	graywacke	argillite · shale · dolomite	limestone	gypsum · halite
TEXTURE	very coarse	coarse	medium	fine	very fine	variable
ORGANIC MATTER CONTENT	low	moderate		high		variable
HUMUS FORM	acid mors	mors and moders		moders and mulls		
SOIL REACTION	extremely acid to medium acid	medium acid to neutral		slightly acid to mildly alkaline		moderately to strongly alkaline
CATION EXCHANGE CAPACITY	low		moderate	high		variable
BASE SATURATION	low		moderate	high		variable
C/N RATIO	high		moderate	low		variable

¹ From Walmsley *et al.* (1990). Note that the presence of nutrient-rich seepage waters may compensate for other factors to create eutrophic conditions.

The classifier generally groups plots by tentative biogeoclimatic unit and by estimated moisture/nutrient regime. The vegetation tables list species by stratum or layer (trees, shrubs, herbs, etc.) in order of presence and mean percent cover for each ecosystem unit. Plots or groups of plots that are floristically different may be separated or moved to another group. Plots that appear similar in moisture and nutrient regime are experimentally merged. Through this process of computer-assisted experimental grouping, rearrangement, and refining of groups, the ecosystem associations are defined (cf. Poore 1962). Ecosystem associations may then be subdivided into types, variations, or phases, often on the basis of edaphic factors as summarized by the environment tables. The degree of lumping or splitting among ecosystem units is largely a matter of personal judgement or, in the case of phases, of operational significance.

Zonal ecosystem associations characterize individual subzones. Subzones that are more similar to each other than they are to any other subzones are then grouped into biogeoclimatic zones. This last taxonomic decision has, to date, been largely subjective, based on the classifiers' concepts of mesoclimate, zonal ecosystem associations, allowable variation within a zone, and the precedent of Krajina (1965, 1973, 1979).

The Ministry of Forests has so far done little mathematical treatment of the data collected and summarized by the ecosystem classification program. However, there are plans for using ordination and other numerical techniques in the near future.

4.3 Mapping

Biogeoclimatic mapping begins with a review of available ecosystem classifications within or near the mapping area. Biogeoclimatic units are characterized and summarized in synopsis form. A draft map, based on physiography and the extrapolation of elevational limits, may be prepared. Field mapping is done along selected transects by ground and air survey. The ground survey includes brief descriptions (rapid

reconnaissance) of vegetation and soils; special attention is paid to zonal ecosystems. Boundaries drawn in the field are based on the type and occurrence of zonal ecosystems, floristic combinations, and the distribution of azonal, edaphic climax ecosystems. Final boundaries are drawn after fieldwork and data analysis have been completed. Boundaries outside transects are extrapolated on the basis of elevation and physiography.

5 GENERAL CHARACTERISTICS OF THE SUBZONE

5.1 Geographic Description

The Northern drier maritime subzone of the Coastal Western Hemlock Zone (CWHf) is found in inland valleys and on eastern slopes of the Coast Mountains, Kitimat Ranges, and on adjacent slopes of the Hazelton Mountains. It lies between approximately $53^{\circ}00'$ and $55^{\circ}30'$ N latitude and $127^{\circ}25'$ and $129^{\circ}30'$ W longitude (see Figs. 4 and 5). Within this area the CWHf encompasses valley bottoms and lower to mid-altitude slopes from approximately 10 m to 1000 m above sea level.

Major valley systems included in the CWHf are the Skeena River between Exstew River and Legate Creek, the Nass River between Greenville and Kwinatah1 River, the Zymoetz, Kitsumkalum, and upper Kitimat valleys. Above the main valley floors, a mid-elevation band of CWHf extends as far east as the Cranberry and Kitsequecla river drainages and high elevation stands are found in the upper Clore River and Telkwa Pass areas. A map showing the known location and extent of the CWHf in the Prince Rupert Region appears in Figure 5.

To the west, the CWHf is bounded by the Central wetter maritime subzone of the Coastal Western Hemlock Zone (CWHi) and to the east it borders on the Interior Cedar - Hemlock Zone, Northwestern transitional subzone (ICHg). At subalpine elevations above the CWHf lie transitional subzones of the Mountain Hemlock (MH) and Engelmann Spruce - Subalpine Fir (ESSF) biogeoclimatic zones.

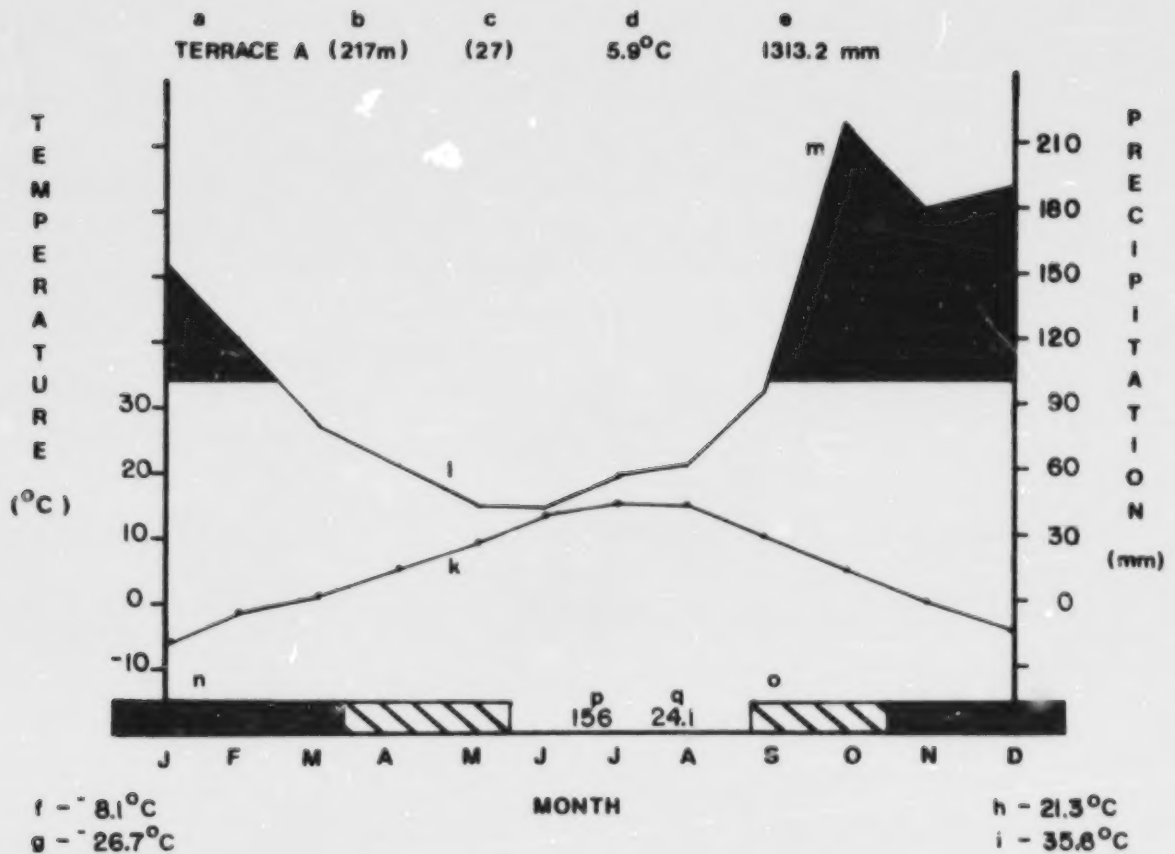
5.2 Climate (Environment Canada 1970; Wilson and Marsh 1975¹)

The climate of the CWHf can be described as sub-oceanic or coastal-transitional (Fig. 6). Because it is somewhat removed from the

¹ R.G. Wilson and R.D. Marsh. 1975. Climatic constraints to logging and climatic suitability for recreation in the Terrace-Hazelton forest resources study area. B.C. Min. Environ., Climate and Data Services Division, Victoria, B.C. Unpublished report.



FIGURE 5. The Coastal Western Hemlock Zone, Northern drier maritime subzone (CWHf), in the Prince Rupert Forest Region.



- a Station.
- b Height above sea level (metres).
- c Duration (years) of observations.
- d Mean annual temperature.
- e Mean annual precipitation.
- f Mean daily minimum temperature of the coldest month.
- g Lowest temperature recorded.
- h Mean daily maximum temperature of the warmest month.
- i Highest temperature recorded.
- k Curve (dotted) of mean monthly temperature.
- l Curve of mean monthly precipitation.
- m Mean monthly precipitation greater than 100 mm.
- n Months with mean daily minimum temperature less than 0° C (black).
- o Months with absolute temperature less than 0° (frosts occur).
- p Mean duration (days) of frost free period.
- q Index of continentality $= 1.7 \frac{(\text{mean temp. July} - \text{mean temp. January})}{(\text{sine degrees latitude})} = 20.4$

FIGURE 6. Representative climatic diagram for the Coastal Western Hemlock Zone, Northern drier maritime subzone (CWHf).

ocean, this subzone does not experience the very humid rainy conditions and mild winter temperatures associated with a truly oceanic climate. Warm, moist maritime air masses move into the region from the Pacific and deposit precipitation on the windward (west-facing) slopes of the Coast Mountains. By the time these air masses reach the CWHf they have lost a significant portion of their initial moisture. For example, Terrace, in the CWHf, receives less than half the total annual precipitation recorded at Prince Rupert.

Summers in the CWHf are characteristically warm and moist. However, unlike the outer coast, this region regularly has significant dry spells during which forest soils may dry out and serious fire hazards build up.

During the winter, maritime arctic air masses predominate in the CWHf. These weather systems deposit heavy loads of moist snow over most of the subzone. Over much of the CWHf, the soil does not regularly freeze before an insulating blanket of snow arrives. On occasions during the winter, continental arctic air from the interior surges down the Skeena and Nass valleys bringing extremely cold and dry weather. These winter cold spells are much more common in the CWHf than on the outer coast but they rarely persist as they do in interior regions.

To summarize, CWHf climate is dominantly coastal in nature, but has significant continental climatic influences. Total growing degree days are higher than on the Coast because cooler winter temperatures are offset by warmer summer weather. The growth of trees is restricted somewhat by the long winter and by occasional summer drought.

5.3 Vegetation (Roche 1969; Daubenmire 1974; Haeussler 1980)

The coastal-transitional nature of the CWHf climate is strongly reflected in its vegetation. The forests have a definite coastal character, but some interior vegetation features are also evident.

Climax forests in the CWHf are dominated by western hemlock (Tsuga heterophylla) which grows in association with amabilis fir (Abies amabilis), western redcedar (Thuja plicata), and spruce. The spruce

appears to be dominantly Sitka spruce (Picea sitchensis) but particularly in eastern sections of the subzone it shows strong introgression with the Interior spruce (Picea glauca x engelmannii). We refer to the dominantly Sitka x white hybrid as Roche spruce. Douglas-fir (Pseudotsuga menziesii) and yellow-cedar (Chamaecyparis nootkatensis) are absent. Subalpine fir (Abies lasiocarpa) is generally lacking except at high elevations in eastern sections of the subzone, where it commonly appears in areas of cold air drainage.

Over most of the CWHf, forest fires are not regularly recurring events as they are in many parts of the interior. However, they do occur sporadically and have a significant influence on natural patterns of vegetation. This contrasts with outer coastal CWH subzones where wildfires are rare events and have had little historic influence on vegetation development.

In much of the CWHf, particularly at higher elevations, natural regeneration following wildfire or other disturbances produces young stands of shade-tolerant conifers that are similar in composition to the original old-growth stand. However, there are significant areas at low elevations in the subzone where seral (non-climax) stands of shade-intolerant tree species have developed following disturbance. Black cottonwood (Populus balsamifera ssp. trichocarpa) and red alder (Alnus rubra) dominate stands that develop along the river bottomlands. Extensive seral stands occur in the wide fluvial valleys of the Skeena and Kitsumkalum rivers and around Lakelse Lake. Lodgepole pine (Pinus contorta var. latifolia) is the dominant species in these stands, but trembling aspen (Populus tremuloides) and paper birch (Betula papyrifera) are also common. Eventual succession to a hemlock-dominated climax is apparent in most of these upland stands.

Specific vegetation features that can be used to characterize the CWHf and distinguish it from neighbouring biogeoclimatic zones and subzones are listed in Table 3.

TABLE 3. A synopsis of vegetation characteristics of the CWHf and adjacent biogeoclimatic zones and subzones

Key: **** widespread and dominant *** widespread ** common * uncommon + rare - absent	CWHf Coastal Western Hemlock Zone, Northern drier maritime subzone	CWHi Coastal Western Hemlock Zone, Central wetter maritime subzone (west of CWHf)	ICHg Interior Cedar-Hemlock Zone, Northwestern transitional subzone (east of CWHf)	MH/ESSF Subalpine Mountain Hemlock and Engelmann Spruce — Subalpine Fir Zones (high elevations above CWHf)
Major climax tree species:				
western hemlock	****	****	****	**
western redcedar	***	***	*** (southern sections only)	+
amabilis fir	***	***	* (higher elevations/ western sections)	**
yellow-cedar	-	**	-	-
subalpine fir	*	-	***	***(*)
mountain hemlock	+	* (frequently in bogs)	+	***(*)
Spruce hybridization	dominantly Sitka characteristics (Roche spruce) <i>Picea sitchensis</i> × <i>glauca</i> or <i>P.</i> <i>sitchensis</i> **(*)	pure Sitka spruce <i>Picea sitchensis</i> **(*)	Interior and Sitka characteristics <i>Picea</i> <i>glauca</i> × <i>sitchensis</i> ? × <i>engelmannii</i> **	variable, dominantly Sitka? <i>Picea sitchensis</i> × <i>glauca</i> ? × <i>engelmannii</i> *
Seral tree species				
red alder	**	***	-	+
black cottonwood	**	** (floodplains only)	**	+
lodgepole pine	** (mainly low elevation)	*	***	*
trembling aspen	* (mainly low elevation)	+	*** (especially southern sections)	-
paper birch	* (mainly low elevation)	+	*** (especially southern sections)	-
Other tree species				
shore pine (<i>Pinus contorta</i> var. <i>contorta</i>)	-	**	-	-
western yew (<i>Taxus brevifolia</i>)	-	*	-	-
black spruce (<i>Picea mariana</i>)	-	-	* (southern sections only)	-
Rocky Mountain juniper (<i>Juniperus</i> <i>scopulorum</i>)	-	-	+ (southern sections only)	-
Climax shrub and herb species				
salal (<i>Gaultheria shallon</i>)	-	*	-	-
deer fern (<i>Blechnum spicant</i>)	+	***	-	-
sword fern (<i>Polystichum munitum</i>)	-	*	-	-
maidenhair fern (<i>Adiantum pedatum</i>)	-	*	-	-
three-leaved goldthread (<i>Coptis trifolia</i>)	*	**	-	-
false lily-of-the-valley (<i>Maianthemum</i> <i>dilatatum</i>)	*	**	-	-
salmonberry (<i>Rubus spectabilis</i>)	***	***	* (northern and western sections only)	-

TABLE 3. (Cont'd)

Key: **** widespread and dominant *** widespread ** common * uncommon + rare - absent	CWHf Coastal Western Hemlock Zone, Northern drier maritime subzone	CWHf Coastal Western Hemlock Zone, Central wetter maritime subzone (west of CWHf)	ICHg Interior Cedar-Hemlock Zone, Northwestern transitional subzone (east of CWHf)	MHESF Subalpine Mountain Hemlock and Engelmann Spruce — Subalpine Fir Zones (high elevations above CWHf)
Climax shrub and herb species—Cont.				
skunk cabbage (<i>Lysichiton americanum</i>)	***	***	* (northern and western sections only)	-
red huckleberry (<i>Vaccinium parvifolium</i>)	***	***	+	+
Alaskan blueberry (<i>V. alaskaense</i>)	****	****	* (northern & western sections only)	***
black huckleberry (<i>V. membranaceum</i>)	**	+	***(*)	***
Sitka valerian (<i>Valeriana sitchensis</i>)	+	+	+	***
Indian hellebore (<i>Veratrum viride</i>)	+	+	+	***
Sitka burnet (<i>Sanguisorba canadensis</i>)	+	+	+	***
pink mountain-heather (<i>Phyllodoce empetrifomis</i>)	+	+	+	***
white mountain-heather (<i>Cassiope mertensiana</i>)	+	+	+	***
partridgefoot (<i>Luetkea pectinata</i>)	+	+	+	***
Seral shrub and herb species				
stink currant (<i>Ribes bracteosum</i>)	*	***	-	*
Nootka rose (<i>Rosa nutkana</i>)	***	**	*	-
goat's-beard (<i>Aruncus dioicus</i>)	**	**	*	**
Pacific crabapple (<i>Malus fusca</i>)	*(*)	**	*	-
hazelnut (<i>Corylus cornuta</i>)	-	-	*** (southern sections only)	-
prickly rose (<i>Rosa acicularis</i>)	*	+	*** (especially southern sections)	+
soopolallie (<i>Shepherdia canadensis</i>)	*	+	*** (especially southern sections)	-
purple peavine (<i>Lathyrus nevadensis</i>)	*	+	*** (especially southern sections)	-
trailing raspberry (<i>Rubus pubescens</i>)	*	+	*** (especially southern sections)	-
rice grasses (<i>Oryzopsis asperifolia</i> , <i>O. pungens</i>)	*	+	*** (especially southern sections)	-
Mosses and liverworts				
<i>Stokesiella oregana</i>	+	***	-	-
<i>Plagiothecium undulatum</i>	+	***	-	-
<i>Isothecium spiculiferum</i>	+	***	-	-
<i>Rhytidiadelphus loreus</i>	****	****	*	*(*)
<i>Plagiochila porelloides</i>	***	***	*(*)	**
<i>Scapania bolanderi</i>	**	***	*	*(*)
<i>Rhytidiadelphus triquetrus</i>	**	*	***(*)	+
<i>Ptilium crista-castrensis</i>	*	+	***	*
<i>Hylocomium splendens</i>	****	****	****	**
<i>Barbilophozia</i> spp.	*	*	**	***

5.4 Geology (Duffell and Souther 1964; Holland 1976; Hutchison et al. 1979)

The bedrock of the CWHf subzone includes mainly coarse crystalline igneous rocks of the Coast Mountains, which evolved during Mesozoic time. Within the most westerly sections of the CWHf, including the Exstew and Shames rivers, acidic granodiorite is very prominent with gneissic granitic rocks forming a lesser component. A small area surrounding the confluence of the Shames and Skeena rivers has a significant outcrop of finer crystalline bedrock including greenstone, shale, and limestone.

Just east of Terrace lies a deposit of non-marine and marine sands and other unconsolidated glacial materials. These sands also extend along the Kitsumkalum and Kitimat river systems.

Northwest and southeast of Terrace lies a fairly large inclusion of granodiorite that extends from Maroon Creek to southeast Lakelse Lake. The mouth of the Zymoetz River also contains granodiorite as well as outcrops of limestone, diorite, and chert.

In the vicinity of Usk is a variety of rocks including chert, limestone, and greywacke. These occasional outcrops of limestone may help to increase the base status (reflected in increased pH) of the surrounding soils.

Relatively fine-grained volcanic rocks including andesite and rhyolite are found in an area between the Oliver and Chindemash creeks.

Within the northern sections of the CWHf subzone, including the Nass Ranges and Nass river system, only one major formation of rocks (Hazelton group) exists. Common bedrock types of the northern areas include siltstone, argillite, greywacke, and conglomerate. Therefore, a variety of mineral grain sizes exists.

In general it can be concluded that much of the bedrock within the CWHf subzone includes coarse crystalline, acidic, igneous rocks. Such rocks are relatively resistant to weathering, due to their high quartz content. Following mechanical breakdown of this igneous bedrock, coarse colluvial rubble and large rocks within till are characteristic surficial

features. Sandy textured tills and outwash are common surficial materials derived from coarse crystalline rocks.

5.5 Surficial Materials (Holland 1976; Baender 1978; Ryder 1978)

There are three physiographic regions within the CWHf subzone: the Coast Mountains; the Hazelton Mountains; and the lower Nass Basin. All of these regions have been heavily glaciated.

Six types of surficial materials exist within the study area. These include glacial till (morainal blankets and veneers), glaciofluvial (outwash), fluvial, colluvial, organic, and marine deposits. For further definitions and descriptions of these terms refer to Appendix 3.

Sandy textured morainal, colluvial, and fluvial materials occupy extensive land areas within the CWHf. These coarse deposits are formed through breakdown of coarse crystalline bedrock following glacial action or in situ chemical, physical, and mechanical weathering.

Along the valley floors of most of the major rivers are sandy to silty fluvial floodplains and terraces. These materials may show a sequential deposition of fluvial layers.

In depressional areas, especially in lowlands of river systems (Zymagotitz, Kitsumkalum, Exstew, Nass), organic blankets and veneers may form over fluvial or lacustrine materials.

Glaciofluvial deposits are common in the lower side valleys or on valley bottoms, adjacent to fluvial and/or morainal materials. Outwash terraces and plains, having rounded sands and gravels, are common landforms of the Kitsumkalum, Skeena, and Kitimat valleys.

Middle to upper valley slope positions support mainly morainal or colluvial surficial materials, and often have a combination of these two. Morainal deposits generally have sandy loam to sandy textures and subrounded coarse fragments. Some morainal landforms show fluvial modification ("water-working"), particularly on lower valley slopes of the Shames River and Williams Creek. Some rounding of glacially deposited coarse fragments is usually evident.

Toward the headwaters of most mountainous rivers and streams within the CWHf, the slope increases sharply. In such steeply sloping valleys, mass wasting and bedrock fracturing are more common and lead to the deposition of colluvial materials. Colluvial blankets may be fairly extensive, and occur on most higher elevation sites within the subzone. Small colluvial fans may form at the base of slides in some valley floors (e.g., along the Skeena River).

Marine clays and sands have been deposited in some small areas northwest of Lakelse Lake and in the vicinity of the lower Nass River.

5.6 Soils

Podzols are the predominant soils of the CWHf. Zonal soils are acidic and tend to be coarse textured. They develop on fluvial, glaciofluvial, morainal, and colluvial deposits. Zonal soils are usually Orthic Humo-Ferric Podzols with loamy, coarse loamy, or sandy textures. High rainfall, mild temperatures, and coarse textures have contributed to strong leaching within zonal soils. Coarse fragment content is often high.

Humus forms¹ of zonal soils are generally thick, often 10-15 cm in depth. Fungal Fq horizons with abundant mycelia (Orthihemimors, Orthihemihumimors) are most common, but the more decomposed H horizons (as in Residuohemihumimors) may be more important in moister areas, and zoogenous Fa horizons (Orthimormoders), in which insect decomposition becomes increasingly important, can also be found. At high elevations, cooler temperatures and heavier snowpacks retard organic matter decomposition, and fungal decay predominates. Here "Myco-" and Orthihemimors with compact, matted F layers predominate. Decaying wood is usually abundant on the forest floor and increases moisture-holding

¹ See Klinka et al. (1981) for a taxonomy of humus forms in British Columbia.

capacity and nitrogen storage within the humus, although too much decaying wood can increase the carbon: nitrogen ratio of the soil and decrease the availability of nitrogen to plants.

Non-zonal ecosystems have a variety of soils. Dry sites may have Orthic Regosols and Eluviated Orthic Dystric Brunisols as well as Humo-Ferric Podzols. Gleyed Humo-Ferric and Ferro-Humic Podzols and Orthic Gleysols have frequently developed on imperfectly drained, moisture-receiving sites. Young fluvial ecosystems generally have Cumulic or Orthic Regosols, or Orthic Dystric Brunisols. Orthic Gleysols and Terric Mesisols usually underlie Sitka spruce - redcedar - Lysichiton americanum swamps. Typic Folisols and folisolic phases of mineral soils become increasingly widespread in the wetter western portions of the study area.

6 GENERAL CHARACTERISTICS OF THE VARIANTS

There is considerable variation in climate within a subzone as large as the CWHf. This climatic variation creates corresponding differences in vegetation, soils, and ecosystem productivity within the subzone. In the CWHf, we recognize elevation and longitude (i.e., distance from the Coast) as being the two primary variables controlling the environmental variation. Elevation and longitude are interrelated because as one moves inland from the coast there is a general increase in the elevation of the valley bottoms. We have therefore subdivided the CWHf into two biogeoclimatic variants:

CWHf1 - low elevation variant (found primarily in western sections of the subzone)

CWHf2 - high elevation variant (found primarily in eastern sections of the subzone)

Figure 7 is a map of the CWHf that shows the distribution of the low and high elevation variants. General characteristics of each of the variants are described below and summarized in Table 4.

6.1 Low Elevation Variant (CWHf1)

6.1.1 Geographic description

The low elevation variant of the CWHf is found in valley bottoms and on sidehills to an elevation of approximately 600 m above sea level. It is mainly distributed in western sections of the subzone within the Kitimat Ranges of the Coast Mountains. Further inland, the CWHf1 is replaced in the valley bottoms by the Interior Cedar-Hemlock Zone (ICH). Major valley systems included within the CWHf1 are the Skeena valley between Legate Creek and Exstew, the Kitsumkalum and upper Kitimat river valleys, and the Nass river valley from the Tseax lava beds to the Ishkheenickh River.



FIGURE 7 Biogeoclimatic variants of the Coastal Western Hemlock Zone, Northern drier maritime subzone (CWHf).

TABLE 4. A summary of the biogeoclimatic variants of the CWHf

CHARACTERISTIC	CWHf1 LOW ELEVATION VARIANT	CWHf2 HIGH ELEVATION VARIANT
Geographic distribution	Skeena R. (Legate Ck. to Exstew); Nass R. (lava beds to Greenville); Kitsumkalum, upper Kitimat, and lower Zymoetz river valleys	above contiguous CWHf1; above ICHg in Skeena valley (Kitseguecla — Legate Ck.) and above Nass, Cranberry, and Kitwanga valleys east of Tseax R.; upper Zymoetz, Clore, and Kiteen river valleys
Physiographic subdivisions	primarily E slopes of Kitimat ranges of Coast Mountains	primarily W slopes of Nass, Bulkley, and Kispiox ranges of Hazelton mountains
Elevational range (m) (approx.)	10–600	600–1000
Climate	warmer, drier than contiguous f2; greater fluctuations in temperature; snowpacks 0.5–1.5 m, moist to wet (late Nov.-Apr.); forest fires quite common	cooler, wetter than contiguous f1; smaller fluctuations in temperature; snowpacks 1.5–4 m, moist and firm (late Oct.–mid May); forest fires rare
Vegetation		
major tree species	Hw ¹ , Ba, Cw, Sxs, B1 absent	Hw, Ba (B1, Sx, Hm) Cw absent
seral stands	extensive in major valleys; dominated by P1; At, Ep, Act, Dr common	rare due to scarcity of fire; P1, At, Ep, Act, Dr uncommon
zonal plant association	Hw — (Ba) — <i>Vaccinium alaskaense</i> — <i>V. ovalifolium</i> — <i>V. parvifolium</i> — <i>Hylocomium splendens</i> — <i>Rhytidiadelphus loreus</i> ; <i>Streptopus streptopoides</i> generally absent	Hw — Ba — (<i>Vaccinium alaskaense</i> — <i>V. ovalifolium</i> — <i>V. membranaceum</i>) — <i>Hylocomium splendens</i> — <i>Rhytidiopsis robusta</i> ; <i>Streptopus streptopoides</i> very common
Landforms	valley bottoms: fluvial terraces and floodplains middle to upper elevations: glaciofluvial outwash, morainal and colluvial deposits	middle to upper slopes: morainal and colluvial veneers and blankets
Zonal soils	sandy textured Orthic Humo-Ferric Podzols	loamy textured Orthic Humo-Ferric Podzols (folisolic phases more common)
Humus depth (cm)	7–18	5–11

¹ Tree species symbols as in Appendix 2.

6.1.2 Climate

Low elevations in the CWHf are characterized by higher temperatures and lower precipitation during the growing season than are found at higher elevations. This means that although temperatures are more favourable to growth within the CWHf, the effective precipitation (moisture available for plant growth) is lower. Slight summer droughts are not unusual on well-drained soils in the CWHf and, as a result, forest fires occur quite commonly.

During the winter, the CWHf receives moderate amounts of moist to wet snow beginning in mid-December and lasting until approximately mid-April. Average maximum snowpacks are estimated to be between 50 and 150 cm in depth. Winter temperatures can become quite cold when a temperature inversion develops in the valley bottoms, but average December - January temperatures are just slightly below freezing, and mid-winter thaws occur frequently.

6.1.3 Vegetation

Climax forests in the low elevation variant are dominated by western hemlock in association with amabilis fir and western red-cedar. Roche or Sitka spruce is common along river bottomlands and on wetter sites and occurs sporadically in upland forest. Subalpine fir is absent. The zonal or climatic climax ecosystem has an understory of Vaccinium shrubs (V. alaskaense, V. ovalifolium, V. parvifolium) and is dominated by the mosses Hylocomium splendens and Rhytidiadelphus loreus.

Seral or non-climax stands are widespread in major valleys of the CWHf, particularly around Terrace. They tend to be dominated by lodgepole pine although mixed stands with trembling aspen and paper birch are also common. Western hemlock is the dominant species of advance regeneration in these stands. Fairly diverse shrub and herb layers and the moss Rhytidiadelphus triquetrus are characteristic of seral stands.

Black cottonwood and red alder are abundant in the CWHf1 along major water courses and also colonize disturbed sites following logging or fire.

6.1.4 Soils¹

Orthic Humo-Ferric Podzols of loamy, coarse loamy, or sandy soil particle size are abundant on fluvialglacial deposits, such as kames and outwash deposits. Whitish surface mineral horizons (Ae) are commonly found above yellowish red to reddish brown Bf horizons. Under strong leaching conditions of high rainfall and coarse soil texture, iron, aluminium, and humus are being removed from the Ae horizons of the CWHf. The Ae horizons are commonly greater than 5 cm thick, although they may be lacking in some profiles.

At lower slope positions, Orthic Regosols and Orthic Humo-Ferric Podzols are found on fluvial landforms such as floodplains, terraces, and fans. Some localized iron cementation of sand particles occurs in coarse-textured soils, particularly at lower elevations of the CWHf1. The Shames, eastern Kitsumkalum, and lower Kitimat river valleys are three general areas where these hard, root-restrictive, cemented layers form.

Organic materials accumulating on mesic (zonal) soil types are generally quite thick in the CWHf1, often between 13 and 15 cm in depth. Decaying wood is very common. Lower humus layers commonly include a black, well-decomposed "Hd" horizon. These well-decomposed horizons have a high surface area for holding and exchanging nutrient cations. Hd horizons also have significant water-holding capacity. Fungal Fq horizons with abundant mycelia

¹ The soil descriptions and comparisons within the variants of the CWHf subzone are based only on soil types with a moderate (mesic) supply of nutrients and moisture.

(Mors) are most prominent (Orthihemimors, Orthihemihumimors) in the CWHf1, although H horizons (as in Residuohemihumimors) may be more important in moister areas, and zoogenous Fa horizons (Orthimormoders), in which insect decomposition is active, can also be found on the richest sites (see Klinka et al. 1981).

6.2 High Elevation Variant (CWHf2)

6.2.1 Geographic description

The high elevation variant of the CWHf is found on mid-mountain slopes and in higher valleys between approximately 600 and 1000 m above sea level. In western sections of the subzone, within the Kitimat Ranges of the Coast Mountains, it occurs as a narrow mid-elevation belt sandwiched between the CWHf1 variant and the Mountain Hemlock Zone (MH). Towards the western boundary of the subzone this middle elevation belt becomes narrower (and somewhat lower) and eventually disappears as the MH zone extends lower in elevation. The high elevation variant is often poorly developed and difficult to recognize in western sections of the subzone, for example, along the Skeena River west of Terrace, because the extremely steep, rocky faces of the Kitimat Ranges prevent a representative climatic climax forest from developing.

Major development of the CWHf2 occurs further inland within the Hazelton Mountains where slopes are less steep and many larger valleys occur above 600 m elevation. In these eastern sections of the subzone, the CWHf2 belt is broad and generally occurs above the Interior Cedar - Hemlock Zone (ICH) and below subalpine forests of the MH or Engelmann Spruce - Subalpine Fir (ESSF) zones. Major areas of CWHf2 are found in the upper Zymoetz and Clore river valleys into the Telkwa Pass area; above the Skeena River between the Kitsequecla valley and Legate Creek; in the upper Kiteen River valley; and on west slopes above the Cranberry and Kitwanga rivers.

6.2.2 Climate

Climates generally become cooler, more humid, and more snowy as elevation increases. These are the basic climatic characteristics that differentiate the high elevation variant from the low elevation variant. Mean temperatures are known to drop 1°C for every 200 m rise in elevation. The effect of these cooler temperatures is a shorter growing season and a lower growing degree-day total for the CWHf2. In addition, daily temperatures are much less subject to fluctuation in the CWHf2 than in adjacent valley bottoms.

Precipitation in the mountains tends to be higher than in the major valleys. However, much of the CWHf2 is located further inland and receives less rainfall than CWHf1 sites to the west. Still, the effectiveness or availability of the precipitation for plant growth is higher in the CWHf2 for two reasons. First, evapotranspiration is lower because of cooler temperatures. Secondly, snowmelt is slower and of longer duration so that moisture from runoff is available for most of the growing season. As a result, soils in the high elevation variant rarely become dry and there are few forest fires.

Winter temperatures are colder overall in the CWHf2 and there are fewer thaws. However, because it is generally above the level of the temperature inversion that develops in valley bottoms, the CWHf2 may often experience warmer temperatures than the f1 variant during cold snaps.

Snowpacks in the CWHf2 are significantly deeper and longer lasting than at lower elevations. Regular snowfalls usually begin in late October and insulate the soil against frost. The snow lasts until mid-May and average maximum snow depths are estimated to range from 1.5 m to as much as 4 m. Snow in the CWHf2 tends to be drier than in the f1 variant. In addition, because it remains on the ground for the entire winter, the snowpack becomes quite firm or

hard as it ages. By comparison, a firm, persistent snowpack does not regularly develop in the CWHf1.

6.2.3 Vegetation

Climatic climax forests in the CWHf2 have a canopy of western hemlock and amabilis fir. There is a significantly higher proportion of amabilis fir in the CWHf2 than in the f1 variant and it is particularly predominant as advance regeneration. Roche spruce is not abundant in the variant, primarily because of the lack of suitable (alluvial) habitat. In eastern valleys of the CWHf2, spruce is somewhat more common, probably because of hybridization with Engelmann spruce, a species well adapted to the high elevation environment. Western redcedar is rare or absent in the CWHf2. It appears only at low elevations and in westernmost sections of the variant. Scarcity of cedar is one of the features used to define the boundary between the CWHf1 and CWHf2.

Subalpine fir is quite common in the high elevation variant, especially in areas of cold air drainage. Its abundance increases significantly from west to east across the variant. Subalpine fir is an edaphic climax species in the CWHf2 and is found most frequently at the margins of the forest along streams and avalanche tracks.

Towards the upper elevations of the variant, mountain hemlock begins to replace western hemlock in the tree canopy. The elevation at which mountain hemlock begins to dominate in numbers and stature over western hemlock is chosen as an arbitrary boundary between the CWHf2 and the MH zone. This elevation is usually between 800 and 1000 m; more than 50% of main canopy cover should be formed by mountain hemlock on a zonal site in the MH.

In general, understory layers contain plants that are adapted to heavy snow loads and a short growing season. Most of the plants found in the CWHf2 occur also in the CWHf1, but there are fewer

species at the high elevations and the proportions or abundance of species differs. Climatic climax or zonal ecosystems are dominated by Rhytidiopsis robusta and Hylocomium splendens mosses rather than by Rhytidiadelphus loreus. Abundance of small twistedstalk (Streptopus streptopoides) and lack of red huckleberry (Vaccinium parvifolium) are two of the best distinguishing features of the CWHf2. Subalpine herbs such as Indian hellebore (Veratrum viride) and Sitka valerian (Valeriana sitchensis) may also be found at upper elevations in the variant.

Seral stands are rare in the high elevation variant because of the scarcity of fire. Lodgepole pine, trembling aspen, paper birch, and associated seral shrub and herb species are therefore generally lacking. Most openings regenerate naturally to hemlock and amabilis fir without passing through a successional stage dominated by shade-intolerant tree species. Black cottonwood is also uncommon because of a lack of suitable habitat and red alder is generally replaced by Sitka alder (Alnus viridis ssp. sinuata) as the invading species on slide tracks and other disturbed areas.

6.2.4 Soils

The CWHf2 contains soils similar to those of the CWHf1. Morainal blankets and veneers are the most common surficial materials. Colluvial deposits occur on the steeper mountainous slopes of the CWHf2, and are more extensive than in the CWHf1 variant.

Orthic Humo-Ferric Podzols are the dominant soils of the CWHf2. Relatively high coarse fragment content and coarse loamy soil textures are common features of the variant. Compaction of fines is not a problem in subsurface horizons of soils within the CWHf2, probably owing to the high precipitation and leaching of fine silts and clays out of the soil layers.

Cooler temperatures and greater snowfall in the CWHf2 result in slower decomposition rates of organic material. Fungal decay predominates within the compact, matted, partially decomposed F layers that dominate the humus.

7 ECOSYSTEM UNITS OF THE CWHF

7.1 Introduction and Definitions

In this section, we outline the classification of ecosystem units in the CWHf. The ecosystem units are grouped into subsections according to the biogeoclimatic variant in which they are found. On the first page of each subsection is a list of the ecosystem units found in the variant. On subsequent pages, each ecosystem unit is described in detail so that it can be easily identified in the field.

The description for each ecosystem association consists of three pages: a general page, including a line drawing; a vegetation page; and a soils page. Descriptions of ecosystem phases and variations are often less detailed. Most of the information included in the ecosystem descriptions is self-explanatory, but some of the terms and symbols may require further explanation.

7.1.1 General description page

Ecological Moisture Regime: refers to the relative amount of moisture available for plant growth. For a synopsis of the moisture regime classes, refer to Table 1.

Ecological Nutrient Regime: refers to the relative amount of nutrients available for plant growth. For a synopsis of the nutrient regime classes, refer to Table 2.

Edatopic Grid Position: the small grid indicates Ecological Moisture Regime (0-7) on its vertical axis and Ecological Nutrient Regime (A-E) on its horizontal axis. The shaded rectangle on the grid indicates the range of moisture and nutrient conditions under which the ecosystem unit develops. Enlarged versions of the grid, properly labelled, appear in Figures 9 (page 55) and 11 (page 86).

Distribution: gives a general idea of how common the ecosystem unit is and where it occurs within the variant.

Physiographic Features: summarizes typical or common site characteristics and indicates where in the landscape one may expect to find the ecosystem unit.

7.1.2 Vegetation page

The vegetation page lists the most common or most important plant species in the ecosystem unit, and comments on relevant features of the plants. Each species is listed by a common name and by its scientific (Latin) name. Most common and scientific names correspond with those used in the publication "A Guide to Some Common Plants of the Skeena Area, British Columbia" (Coupé et al. 1982), which is designed to be used in conjunction with this guide. Occasionally, when a plant species immediately follows another belonging to the same genus, the name of the genus is abbreviated (e.g. Vaccinium ovalifolium, V. alaskaense). A complete list of plant species appears in Appendix 1.

The plants are listed according to strata or layers which are defined as follows:

Trees: woody plant exceeding 10 m in height. In extreme habitats, such as bogs, tree species are often stunted and less than 10 m tall. However, we still list them in the tree layer and comment on their reduced height. Note that the tree species listed represent those found in mature climax or at least advanced successional stands (unless otherwise indicated). Young stands may have a very different species composition.

Shrubs: woody plants between approximately 30 cm and 10 m in height. Note that once a species has been recorded in the

tree layer, we do not list it again in the shrub layer, even if seedlings and saplings below 10 m are present. In some cases, however, we do comment on the importance of advance regeneration in the shrub layer.

Herbs: all herbaceous (non-woody) plants, including ferns, plus all trailing woody plants and dwarf shrubs that do not normally exceed 30 cm in height. For example, the dwarf shrub kinnikinnick (Arctostaphylos uva-ursi) is always included in the herb layer because of its low growth habit.

Moss layer: includes mosses, liverworts, and lichens growing on the forest floor. Note that unless otherwise indicated in the comments, we do not include species growing on decaying wood or on living plants. We do not list common names for most species in this layer. However, the term feather moss is used to refer collectively to the three mosses Pleurozium schreberi, Hylocomium splendens, and Ptilium crista-castrensis; leafy mosses are all species belonging to the genus Mnium (also known as Rhizomnium or Plagiomnium). Peat moss refers to Sphagnum mosses.

Within each layer, the species are listed more or less in order of importance, although the order varies from site to site in the field. The list does not include all species found in an ecosystem unit, just those that are most common or most important in terms of cover or indicator value. Cover refers to the abundance or percentage of ground surface occupied by the plant. Indicator value refers to how much a plant can tell you about the growing conditions on the site. Some plants, like bunchberry (Cornus canadensis) are poor indicators because they will grow almost anywhere. Other plants, such as enchanter's nightshade (Circaea alpina) are very

choosy about their habitat requirements and therefore are good indicators of site conditions such as moisture, nutrients, light, and climate. Where possible, we have tried to specify the indicator value of a species.

Species enclosed in square brackets [] either have low cover, or are not consistently present. They are always less important than species without brackets.

The abbreviation "sp." after the name of a plant genus (e.g., Viola sp.) refers to a single, unknown species, while "spp." refers to several unnamed species belonging to the genus (e.g., Sphagnum spp.). Occasionally we recognize subdivisions of a species, called subspecies. These are abbreviated "ssp." (e.g., Alnus viridis ssp. sinuata).

7.1.3 Soils page

The soils page attempts to summarize those soil features that aid in classification and identification of the ecosystem unit. In many cases, soil profiles described within an ecosystem association are extremely variable. Similarities between soil features such as texture, colour, volume of coarse fragments, and depth of organic layers may aid in the identification of an ecosystem unit. The use of statements regarding nutritional status or texture of a horizon should not be taken as definite, owing to a lack of chemical or physical lab analysis of these soils. A brief description of the soil page format follows:

Soils: includes a paragraph summarizing the basic morphological features of the soil pedon, such as colour, texture, depth of humus, etc. These are the features that would appear most obvious to an observer standing back and looking into the soil pit.

Soil Classification: classifies the most common soils within each ecosystem unit, based on Canadian Soil Survey Committee, Subcommittee on Soil Classification (1978).

Humus Form Classification: refers to the classification of surface organic materials and is based on Klinka et al. (1981).

Schematic Profile: presents a simplified diagram of a "typical soil profile" within an ecosystem unit. Horizon designations and a brief description of important or dominating horizons are also given. The most important morphological features of the horizons may be mentioned such as colour, texture, structure, abundance of roots, presence or absence of mottling, and acidity. Parenthesis around a horizon designation, e.g., (Bm) are used either (1) to suggest the horizon may occur, but is not the most common; or (2) in cases where two profiles are described. Parentheses around horizons correspond to the soil name in parentheses below the profile. Colour names used in profile descriptions come from the Munsell Colour Chart. For a breakdown of sand (S), silt (Si), and clay (C) into textural classes, refer to the textural triangle in Figure 8.

Average pH: mineral horizons - refers to the weighted average of pH values within the upper 50 cm of the mineral soil (or less if lithic contact occurs).

Average pH: organic horizons - refers to the weighted average of pH values for organic horizons (L,F,H) above the mineral surface, or to a maximum depth of 50 cm for non-freely drained organic soils (Of, Om, Oh).

Key Characteristics: this includes, in point form, some features that may help to identify soils of a particular ecosystem unit from other units. This section focuses on some of the key features that occur in most profiles within a particular unit.

A brief concluding section (Comments) may follow.

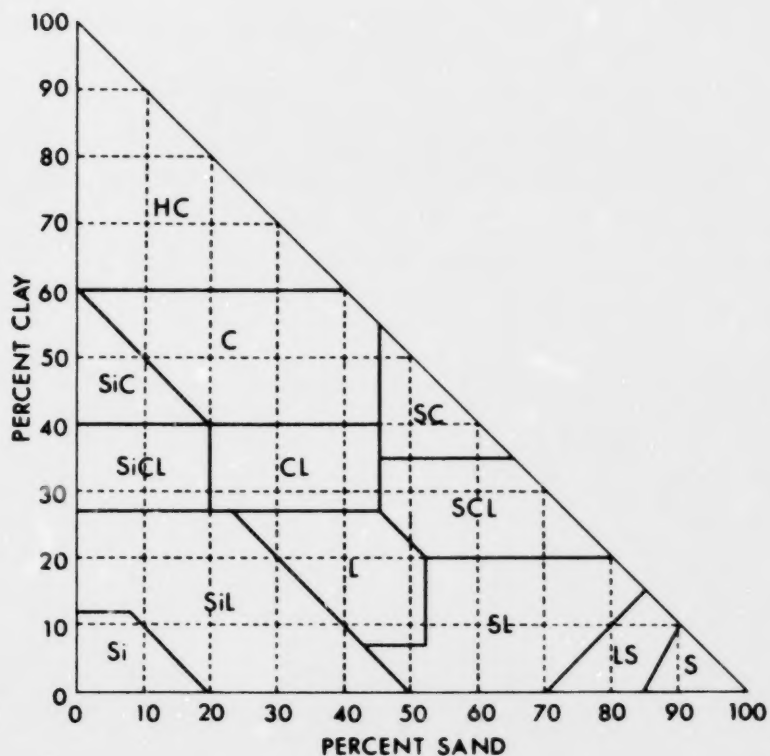


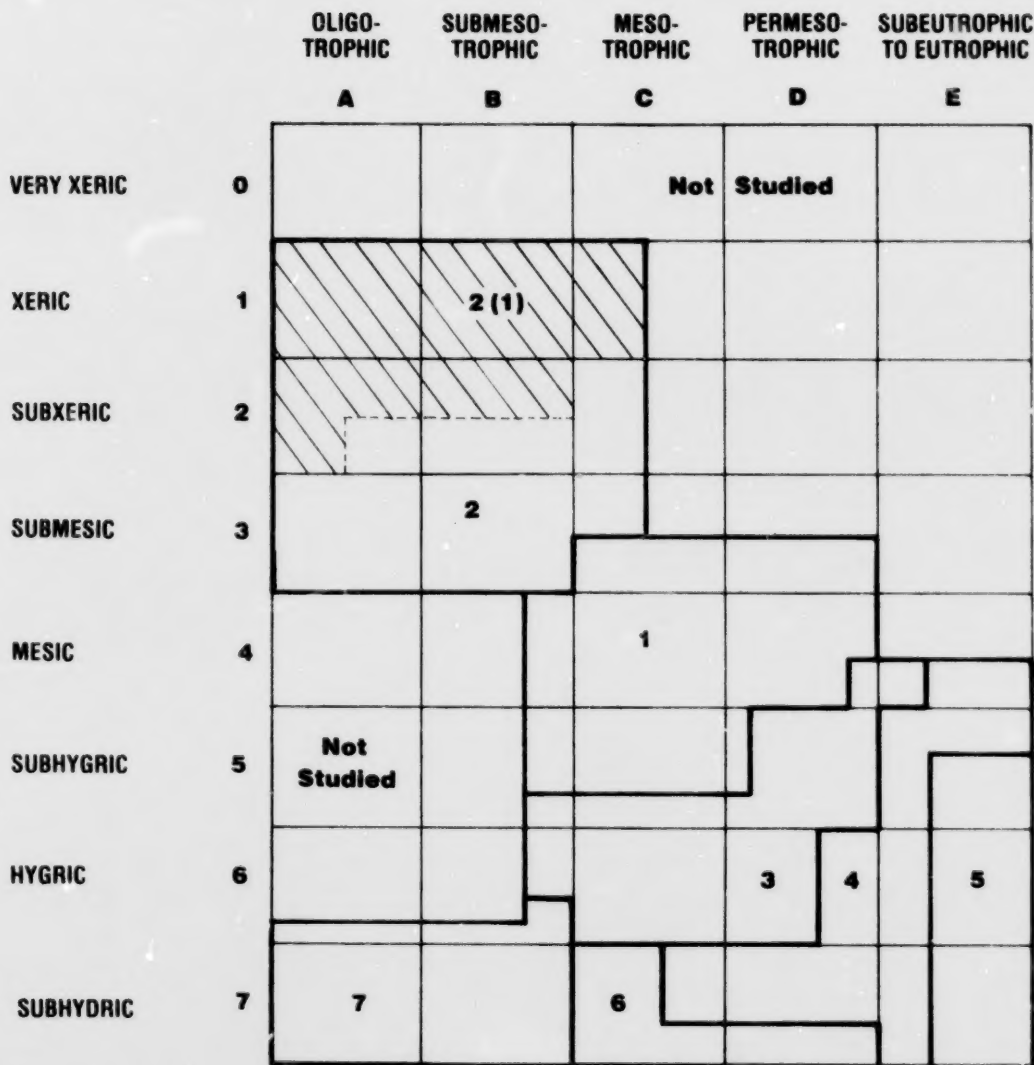
FIGURE 8. Soil textural triangle. Soil texture classes represent the percentages of clay and sand in the main textural classes of soil; the remainder of each class is silt.

7.2 Classification of Ecosystem Units of the CWHf1: Low Elevation Variant.

- /01 Zonal hemlock - Vaccinium - moss ecosystem association
 - /01(1) Moss variation
- /02 Dry hemlock - moss ecosystem association
 - /02(1) Outwash pine variation
- /03 Devil's club - oak fern ecosystem association
- /04 Devil's club - lady fern - oak fern ecosystem association
- /05 Fluvial spruce - devil's club - fern ecosystem association
 - /05(1) Floodplain cottonwood variation
- /06 Skunk cabbage ecosystem association
- /07 Bog ecosystems

ECOLOGICAL NUTRIENT REGIME

ECOLOGICAL MOISTURE REGIME



- 1 Zonal hemlock - Vaccinium - moss
- 2 Dry hemlock - moss
- 2 (1) Outwash pine variation
- 3 Devil's club - oak fern
- 4 Devil's club - lady fern - oak fern
- 5 Fluvial spruce - devil's club - fern
- 6 Skunk cabbage
- 7 Bog ecosystems

FIGURE 9. Edatopic grid of ecological moisture and nutrient regimes - CWHf1.

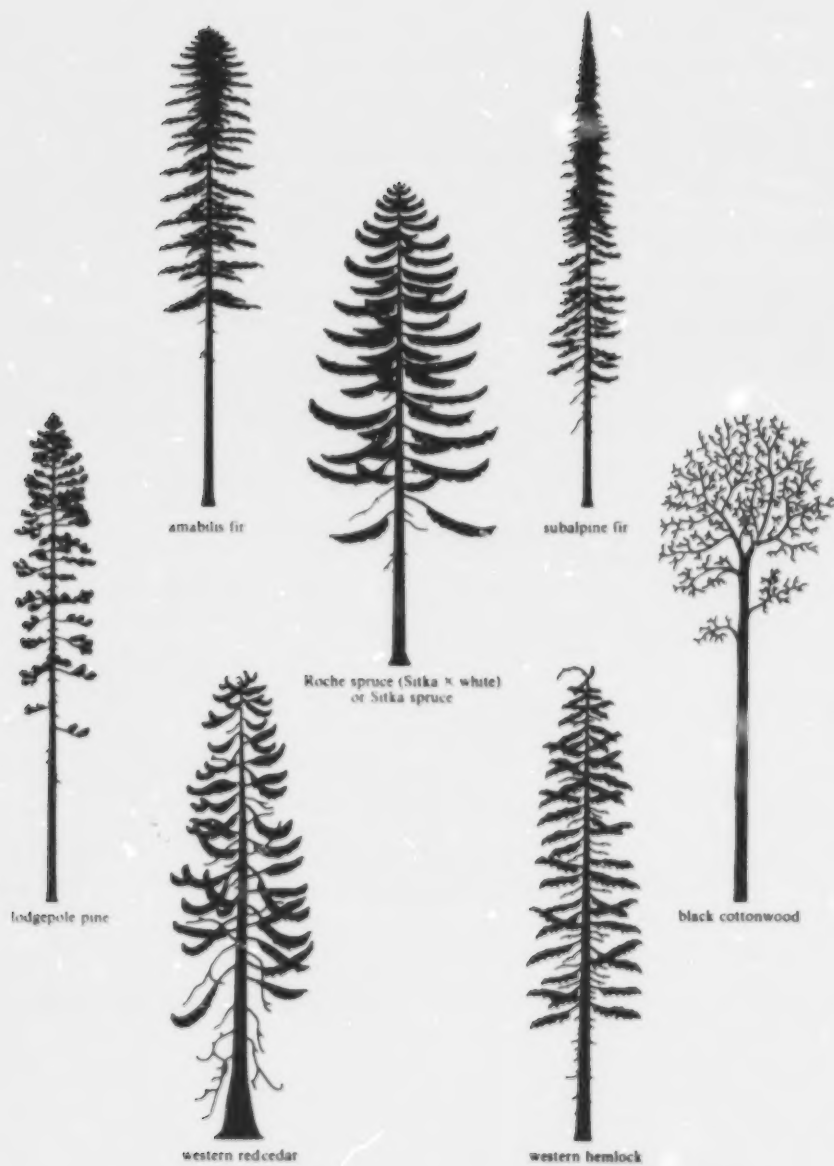
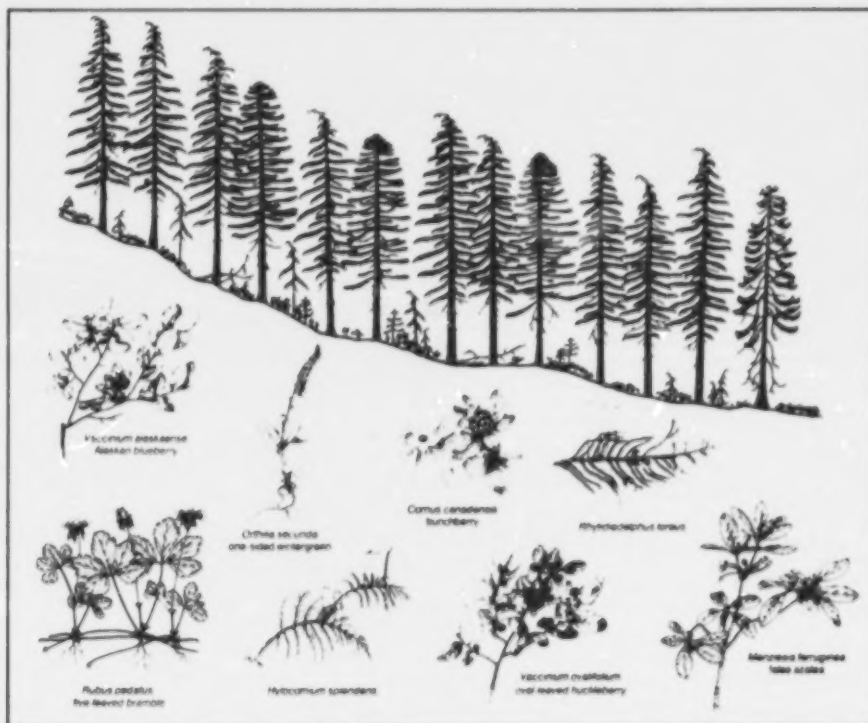


FIGURE 10. Tree species silhouettes used in the slope diagrams.

CWHf1: LOW ELEVATION VARIANT

/01 ZONAL HEMLOCK - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION



	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

ECOLOGICAL MOISTURE REGIME:

(submesic +) - mesic - (subhygric)

ECOLOGICAL NUTRIENT REGIME:

(submesotrophic) - mesotrophic - (permesotrophic)

DISTRIBUTION: This is the most widely distributed ecosystem association in the CWHf1. It is found throughout, along valley bottoms and up mountain slopes.

PHYSIOGRAPHIC FEATURES:

Slope position: (upper) middle to lower slopes; less commonly on valley floors and terraces.

Slope range: gentle to very steep; occasionally flat (0-70%+).

Surface shape: variable; straight, slightly convex or concave; rarely flat.

Landforms: morainal and colluvial blankets and veneers; glaciofluvial terraces; occasional fluvial deposits.

CWHF1/01 ZONAL HEMLOCK - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees:

western hemlock	(<u>Tsuga heterophylla</u>)	-dominant cover
amabilis fir	(<u>Abies amabilis</u>)	
[western redcedar	(<u>Thuja plicata</u>)]	
[Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)]	

Shrubs: moderately to well developed layer (ca. 15-75% cover); advance regeneration often heavy.

Alaskan blueberry	(<u>Vaccinium alaskaense</u>)	-dominant
oval-leaved blueberry	(<u>Vaccinium ovalifolium</u>)	
red huckleberry	(<u>Vaccinium parvifolium</u>)	
false azalea	(<u>Menziesia ferruginea</u>)	

Herbs: poorly to moderately well developed layer.

bunchberry	(<u>Cornus canadensis</u>)
five-leaved bramble	(<u>Rubus pedatus</u>)
queen's cup	(<u>Clintonia uniflora</u>)
one-sided wintergreen	(<u>Orthilia secunda</u>)

Moss layer: usually a well developed, solid carpet of mosses.

<u>Rhytidiadelphus loreus</u>	-dominant towards the Coast
<u>Hylocomium splendens</u>	-dominant towards the Interior
<u>Rhytidiopsis robusta</u>	
[<u>Pleurozium schreberi</u>]	
[<u>Plagiochila porelloides</u>]	-consistently present but with low cover

Remarks: This ecosystem association contains the zonal or climatic climax vegetation for the low elevation variant of the CWHF. The cover of shrubs is extremely variable but they are usually the dominant visual feature of the forest understory. Spruce, although only sporadically present, is usually the largest tree in the stand. Amabilis fir is mostly a subdominant tree but may outgrow hemlock on the wettest examples of this unit.

CWHF1/01 ZONAL HEMLOCK - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION

SOILS: These soils have developed on coarse-textured surficial materials receiving moderate moisture and nutrients. Profiles show good podzolic development, with an acidic pale brown (Ae) horizon overlying well-drained yellowish red (Bf) layers. Lower yellowish brown horizons may contain abundant coarse fragments (colluvial), although this feature is not prominent on all landforms. Root-restrictive lithic contacts or ortsteins may occur within 80 cm of the mineral surface. Very acidic organic materials have accumulated to depths of 5 to 20 cm, with the rate of decomposition relatively slow (F horizons dominating).

Soil Classification: Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile:

Horizon	Description
S/L	- undecomposed litter and moss layer.
F	- slightly to moderately decomposed; dark brown; plentiful fine, medium roots.
H	- (if present) well decomposed; black; abundant medium, coarse roots.
Ae	- light brownish gray; sandy loam; few fine roots; very acidic.
Bf	- yellowish red to strong brown; loamy sand; single grain; plentiful fine, medium, coarse roots.
BC	- yellowish brown; sand; single grain; few fine roots.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.7
organic horizons - 2.7

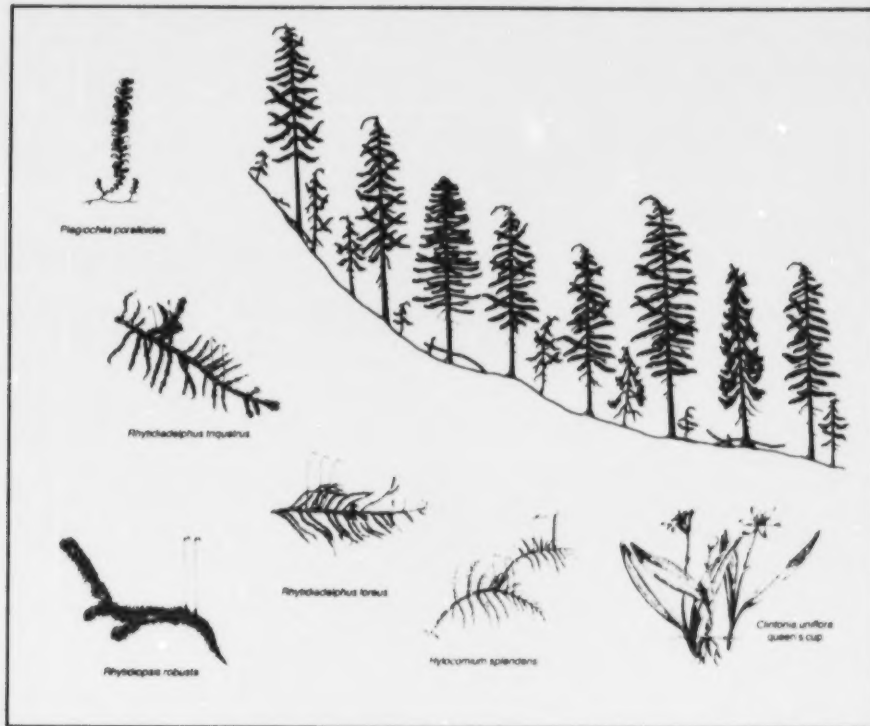
Key Characteristics:

- coarse-textured soils, rapidly drained, occurring at middle to upper slope positions (where temporary moisture deficiencies may develop).
- very acidic, leached, whitish coloured horizons are found at the mineral surface.
- on colluvial deposits, coarse fragment content and organic matter accumulation increase in mineral horizons.
- soils have developed on a variety of landforms.
- effective rooting generally less than 65 cm.

Comments: Soils are well aerated and relatively coarse textured. Although precipitation is high, some brief moisture deficiencies may develop in these well to rapidly drained soils. Thicker organic layers may aid moisture retention.

CWHf1: LOW ELEVATION VARIANT

/01(1) ZONAL HEMLOCK - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION: MOSS VARIATION



	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

ECOLOGICAL MOISTURE REGIME:

(submesic +) - mesic - (subhygric-)

ECOLOGICAL NUTRIENT REGIME:

(submesotrophic) - mesotrophic - (permesotrophic)

DISTRIBUTION: This variation of the zonal ecosystem association is less common than the typical Hemlock - Vaccinium - moss. It is found mainly in central and eastern portions of the CWHf1 where continental climatic influences are strong.

PHYSIOGRAPHIC FEATURES:

Slope position: mostly middle to lower slopes; rarely on valley floors and terraces.

Slope range: gentle to very steep; rarely level ((0)20 - 70%+).

Surface shape: variable; generally not concave.

Landforms: morainal and colluvial blankets; occasionally fluvial or fluvio-glacial deposits.

CWHf1/01(1) ZONAL HEMLOCK - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION: MOSS
VARIATION
VEGETATION:

Trees:

western hemlock	(<u>Tsuga heterophylla</u>)	-dominant cover
amabilis fir	(<u>Abies amabilis</u>)	
[western redcedar	(<u>Thuja plicata</u>)]	
[Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)]	

Shrubs: very poorly developed layer, often lacking; cover of conifer regeneration may be significant.

[Alaskan blueberry	(<u>Vaccinium alaskaense</u>)]	-trace only, very low vigour
--------------------	----------------------------------	------------------------------

Herbs: sparse; usually of low vigour, variable composition.

[rattlesnake-plantain	(<u>Goodyera oblongifolia</u>)]	) -most frequently
[queen's cup	(<u>Clintonia uniflora</u>)]	) present
[bunchberry	(<u>Cornus canadensis</u>)]	)

Moss layer: well developed; solid carpet of mosses.

<u>Hylocomium splendens</u>	-dominant
<u>Rhytidiadelphus loreus</u>	
[<u>Rhytidiadelphus triquetrus</u>]	) -consistently pre-
[<u>Plagiochila porelloides</u>]	) sent but not
	) dominant
[<u>Rhytidiopsis robusta</u>]	-occasionally dominant

SOILS: Similar to those of the Zonal hemlock - Vaccinium - moss ecosystem association. Refer to description for the CWHf1/01.

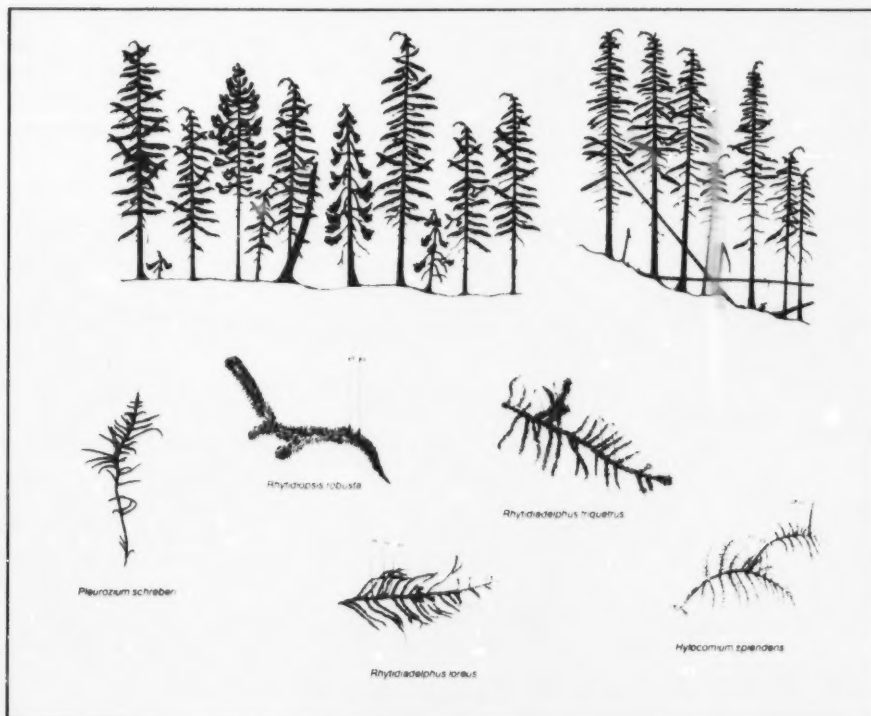
Remarks: Aside from its vegetation characteristics, the Moss variation appears little different from the Zonal hemlock - Vaccinium - moss ecosystem association. We do not fully understand why the shrub layer is absent from some mesic ecosystems in the CWHf1. The Moss variation may reflect local climatic influences such as a heavy snow pack on north-facing slopes or colder continental conditions such as those found in the Interior Cedar-Hemlock Biogeoclimatic Zone. It may also reflect the nature of

stand development. When coniferous regeneration is very dense following fire or blowdown, shrub species are excluded because of lack of light, and may remain absent for long periods after the stand opens up.

Because we cannot yet specify soil, physiographic, or productivity differences that differentiate the Moss variation from Hemlock - Vaccinium - moss, we are treating them together for management purposes. However, it is important not to confuse the Moss variation with the Dry hemlock - moss e.a. (CWHf1/02). Although the two ecosystem units are similar in appearance, there are significant differences in environmental conditions and site quality. The Moss variation can be distinguished from the Dry hemlock - moss by: (1) better vigour of all tree species, especially amabilis fir; (2) lodgepole pine is usually not present; (3) herbs indicating wetter site conditions such as oak fern (Gymnocarpium dryopteris), foamflowers (Tiarella spp.), and twistedstalks (Streptopus spp.) may be scattered in wetter microsites; and (4) there is a greater diversity of moss and liverwort species including Plagiochila porelloides and some Mnium mosses.

CWHf1: LOW ELEVATION VARIANT

/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:
(subxeric) - submesic - (mesic-)

ECOLOGICAL NUTRIENT REGIME:
submesotrophic - mesotrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Widespread on valley floors and hillsides throughout the CWHf1.
Especially common in areas with coarse-textured or shallow soils.

PHYSIOGRAPHIC FEATURES:

Slope position: upper to middle slopes, ridges, valley floors and terraces;
moisture-shedding positions.

Slope range: level to very steep.

Surface shape: convex, straight, flat.

Landforms: morainal and colluvial veneers over rock; some deeper coarse-textured morainal or fluvial deposits; glaciofluvial terraces.

CWHf1/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: usually dense, small in diameter.

western hemlock	(<u>Tsuga heterophylla</u>)	-overall dominant cover
lodgepole pine	(<u>Pinus contorta</u>)	-overmature, seral remnants frequently present
[western redcedar	(<u>Thuja plicata</u>)]	-low vigour, usually below main canopy

Shrubs: very poorly developed, generally absent.

[huckleberry/blueberry	(<u>Vaccinium</u> spp.)]	) -all of low vigour,
[falsebox	(<u>Paxistima myrsinites</u>)]	) very scattered,
[false azalea	(<u>Menziesia ferruginea</u>)]	) mainly in stand openings

Herbs: very poorly developed, frequently absent.

[rattlesnake plantain	(<u>Goodyera oblongifolia</u>)]	) -scattered small
[one-sided wintergreen	(<u>Orthilia secunda</u>)]	) patches or
[prince's pine	(<u>Chimaphila umbellata</u>)]	) individuals
[round-leaved rein-orchid	(<u>Platanthera orbiculata</u>)]	)
[spotted coralroot	(<u>Corallorhiza maculata</u>)]	)

Moss layer: a well developed, thick carpet of moss.

<u>Hylocomium splendens</u>	-generally dominant
<u>Rhytidiadelphus loreus</u>	) composition
<u>Rhytidiadelphus triquetrus</u>	) variable
<u>Rhytidiopsis robusta</u>	)
<u>Pleurozium schreberi</u>	)

Remarks: The dominant visual features of this ecosystem association are the absence of herbs and shrubs, and the usually dense canopy of small trees. These are poor growing sites for most tree species. Spruce is only rarely present and amabilis fir, when present, performs poorly. Refer to discussions on page 61 for differences between the Moss variation of the Zonal hemlock - Vaccinium - moss e.a. [CWHf1/01(1)] and the Dry hemlock - moss e.a.

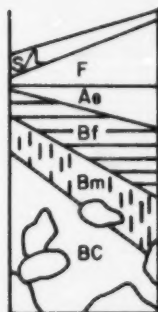
CWHf1/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

SOILS: On drier, shedding positions (upper slopes, bedrock knobs) soils receive less moisture, and water is retained for only short periods. This shortage of moisture is reflected in the poor profile development. Brownish brunisolic (Bm) and podzolic (Bf) horizons are generally coarse textured, and may contain an abundance of coarse fragments which leads to rapid drainage. Relatively thin, weakly decomposed organic horizons ranging from 5 to 10 cm in depth, have formed in these dry ecosystems.

Soil Classification: Orthic Humo-Ferric Podzols and Eluviated Dystric Brunisols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed; dark brown; plentiful fine, medium roots; abundant white mycelia; very acidic.
Ae	- light brownish gray; loam; few coarse roots; very acidic.
Bf	- yellowish red; loamy sand; plentiful medium, coarse roots.
Bm	- yellowish brown; loamy sand; plentiful medium roots; granular.
BC	- yellowish brown; sandy to clay loam; single grain to massive; high coarse fragment content.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.7
organic horizons - 3.0

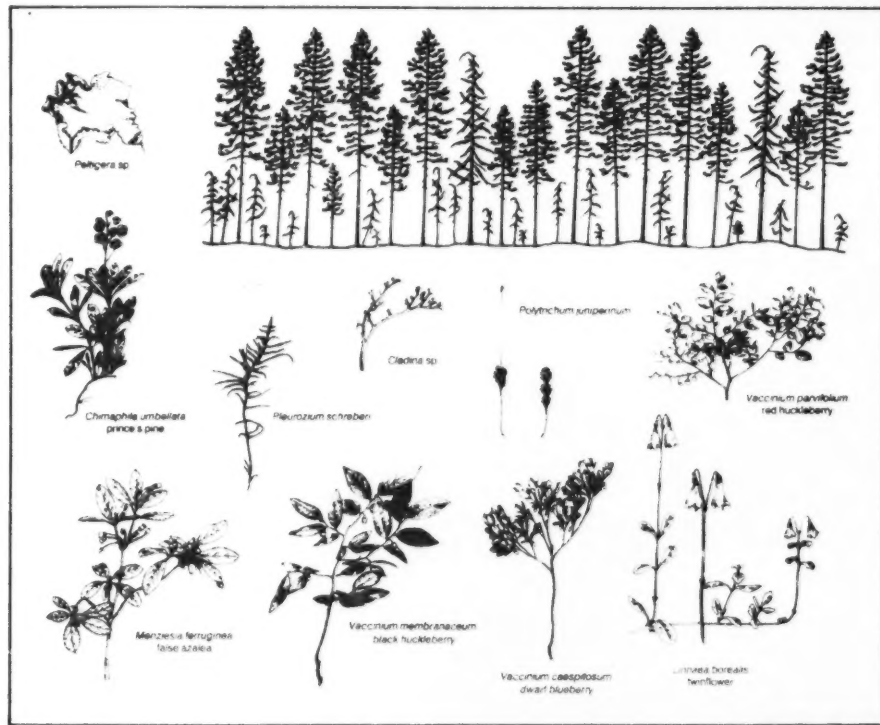
Key Characteristics:

- high coarse fragment content (greater than 50%) and/or coarse sandy textures result in rapid drainage.
- rooting occasionally restricted by compacted layers below 50 cm.
- wide variety of fluvial, morainal, and colluvial deposits, generally in shedding, upper slope positions.
- very acidic organic materials develop on the surface, and fungal decomposition is relatively slow.

Comments: The Dry hemlock - moss ecosystem association could probably be subdivided into three phases (lithic, gravelly, and bouldery colluvial), but we lack sufficient sampling to characterize these phases.

CWHF1: LOW ELEVATION VARIANT

/02(1) DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: OUTWASH PINE VARIATION



ECOLOGICAL MOISTURE REGIME:
xeric - subxeric - submesic

ECOLOGICAL NUTRIENT REGIME:
(oligotrophic +) - submesotrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Common on outwash terraces at low elevations in major valleys such as the Kitsumkalum, upper Kitimat, and Skeena (extremely dry Pine-lichen ecosystems on ridges or rock outcrops may also be included with this variation).

PHYSIOGRAPHIC FEATURES:

Slope position: valley floors, terraces, plains (occasionally ridges or rock knobs).

Slope range: level (0-5%).

Surface shape: smooth, flat, (+ convex).

Landforms: mainly coarse textured, glaciofluvial outwash terraces; (also some shallow moraine or colluvium over rock), eskers, kames.

CWHf1/02(1) DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION: OUTWASH PINE VARIATION

VEGETATION:

Trees: small in diameter and height growth, often densely overstocked.

lodgepole pine	(<u>Pinus contorta</u>)	-dominant cover
western hemlock	(<u>Tsuga heterophylla</u>)	-most common in understory
[mountain hemlock	(<u>Tsuga mertensiana</u>)]	-appears on some driest examples of this variation

Shrubs: poorly to moderately developed layer.

false azalea	(<u>Menziesia ferruginea</u>)	
black huckleberry	(<u>Vaccinium membranaceum</u>)	
red huckleberry	(<u>Vaccinium parvifolium</u>)	
[Saskatoon	(<u>Amelanchier alnifolia</u>)]	-a seral remnant, very low vigour

Herbs: sparse to low cover, never lush.

twinflower	(<u>Linnaea borealis</u>)	
prince's pine	(<u>Chimaphila umbellata</u>)	
dwarf blueberry	(<u>Vaccinium caespitosum</u>)	
bunchberry	(<u>Cornus canadensis</u>)	
pink wintergreen	(<u>Pyrola asarifolia</u>)	
[narrow-leaved cow-wheat	(<u>Melampyrum lineare</u>)]	-excellent indica-
[kinnikinnick	(<u>Arctostaphylos uva-ursi</u>)]	) tors of a very dry site, when present

Moss layer:

<u>Pleurozium schreberi</u>	-dominant
<u>Peltigera</u> spp.	
<u>Hylocomium splendens</u>	
<u>Rhytidiadelphus triquetrus</u>	
[<u>Polytrichum juniperinum</u>]	-low cover but good
[<u>Dicranum polysetum</u>]	) dry site indicators
[<u>Cladonia</u> spp.]	-these fruticose
[<u>Cladina</u> spp.]	) (branched) lichens
[<u>Stereocaulon</u> sp.]	) have significant cover on the driest examples of the variation

Remarks: These seral pine ecosystems represent the driest extreme of the Dry Hemlock - moss ecosystem association in the CWHf. Because of the

predominance of western hemlock in understory layers, there is little doubt that, left undisturbed, these ecosystems will eventually develop into a Hemlock - moss climax. However, frequent fire may maintain the seral condition for many generations. Therefore, we recognize these ecosystems in a distinct variation of the Hemlock - moss ecosystem association.

The gnome plant (Hemitomes congestum), a very rare saprophyte (plant that lives on dead organic matter), seems to be unusually common in ecosystems belonging to this variation.

This variation can be distinguished from young Hemlock - Vaccinium - moss (CWHf1/01) ecosystems by the predominance of lodgepole pine, general lack of amabilis fir, cedar, and spruce, and the slow growth rate of all tree species. Scarcity of Vaccinium alaskaense and V. ovalifolium and presence of the dry site indicators noted above are other characteristic features.

CWHf1/02(1) OUTWASH PINE VARIATION

SOILS: With respect to soils, the major factor differentiating the Outwash pine variation from the Dry hemlock - moss (CWHf1/02) ecosystem association is the dominance of well-sorted and stratified glaciofluvial deposits. Soil textures are therefore gravelly sands which are rapidly drained. Profile development is generally the same as CWHf1/02, with yellowish red to yellow brown mineral horizons (Bf) dominating. Only thin organic layers develop.

Soil Classification: Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile: refer to descriptions under CWHf1/02

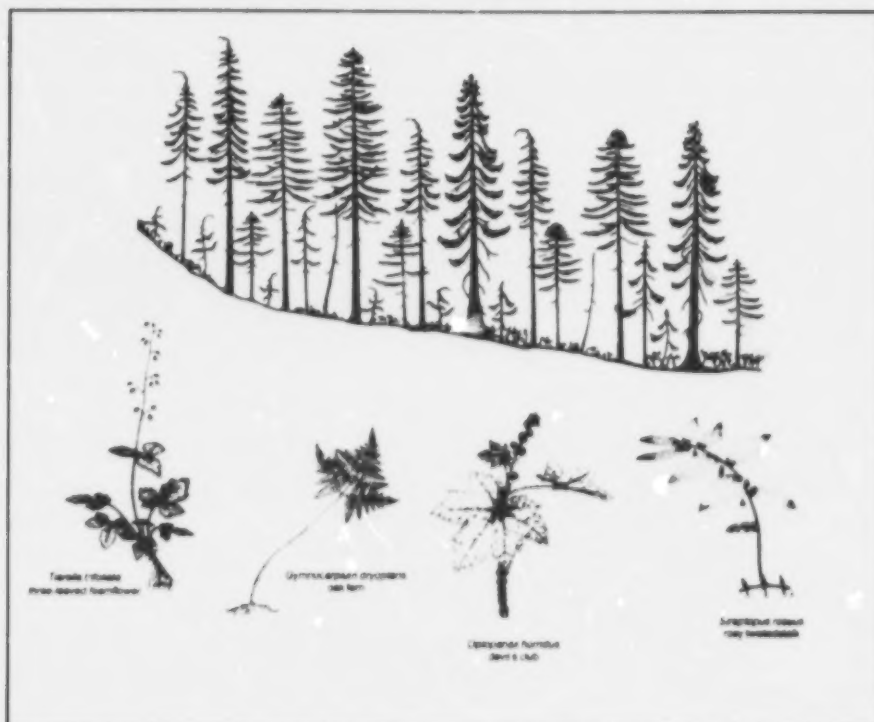
Average pH: mineral horizons - 4.9
 organic horizons - 3.1

Key Characteristics:

- coarse gravelly sands which are highly porous and rapidly drained.
- acidic, weakly decomposed, dry organic layers reach depths of only 4-7 cm and have a minimal capacity to retain water.
- soils may be very shallow on bedrock knobs, rendering them very susceptible to erosion.
- moisture deficiencies would be frequent.

CWHf1: LOW ELEVATION VARIANT

/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:

subhygric - (hygric -)

ECOLOGICAL NUTRIENT REGIME:

mesotrophic - permesotrophic - (subeutrophic)

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Found throughout the CWHf1, very common but usually not covering large areas.

PHYSIOGRAPHIC FEATURES:

Slope position: (middle -) lower slopes, minor depressions and drainages, valley floors; positions receiving some seepage.

Slope range: level to very steep, but usually gently sloping.

Surface shape: concave (straight).

Landforms: fluvial, glaciofluvial, or morainal deposits; some fluvial veneers over moraine.

CWHF1/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: composition variable; most trees have good vigour.

western hemlock	(<u>Tsuga heterophylla</u>)	
western redcedar	(<u>Thuja plicata</u>)	
amabilis fir	(<u>Abies amabilis</u>)	
[Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)]	-usually the largest tree but not always present

Shrubs: moderately to well developed, fair to good vigour.

devil's club	(<u>Oplopanax horridus</u>)	-usually dominates shrub layer
black gooseberry	(<u>Ribes lacustre</u>)	-a good indicator, usually present
oval-leaved blueberry	(<u>Vaccinium ovalifolium</u>)	
false azalea	(<u>Menziesia ferruginea</u>)	
[highbush-cranberry	(<u>Viburnum edule</u>)]	-good indicator
[red elderberry	(<u>Sambucus racemosa</u>)]	) species but only rarely present, low vigour

Herbs: moderately to well-developed layer; fairly diverse.

oak fern	(<u>Gymnocarpium dryopteris</u>)	-characteristic dominant
foamflowers	(<u>Tiarella trifoliata</u> , <u>T. unifoliata</u>)	)
twistedstalks	(<u>Streptopus roseus</u> , <u>S. amplexifolius</u>)	-good indicators, always present
five-leaved bramble	(<u>Rubus pedatus</u>)	)
queen's cup	(<u>Clintonia uniflora</u>)	-not good indicators but
one-sided wintergreen	(<u>Orthilla secunda</u>)	) indicators but very common, good
bunchberry	(<u>Cornus canadensis</u>)	) vigour
[baneberry	(<u>Actaea rubra</u>)]	-good indicators
[spiny wood fern	(<u>Dryopteris assimilis</u>)]	) but not always present

Moss layer: fairly well developed and dominated by mosses, but often hidden from view by herbs and shrubs.

<u>Hylocomium splendens</u>	-dominate on high
<u>Rhytidiadelphus triquetrus</u>	) ground
<u>Rhytidiadelphus loreus</u>	)
[<u>Plagiochila porelloides</u>]	
[<u>Mnium</u> spp.]	-mainly in pockets and depressions

Remarks: Both western redcedar and amabilis fir are often important components of the tree layer and appear to grow well. Amabilis fir is frequently taller than hemlock in the mature stand.

Note that very wet/rich site indicators such as lady fern (Athyrium filix-femina), enchanter's nightshade (Circaea alpina), violets (Viola spp.) may be present, but they are usually small and confined to the wettest depressions.

CWHf1/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION

SOILS: Due to abundant precipitation and relatively good drainage, soil profiles show an increased tendency toward Podzol formation. Most soils show evidence of fluvial washing in combination with morainal or colluvial deposits. Fluvial deposition of minerals may result in sites slightly richer than mesotrophic. Yellowish brown, gravelly sands tend to dominate Brunisolic profiles, while reddish brown, loamy horizons generally dominate the upper 20 cm of Podzolic soils. Organic layers range from 5 - 11 cm in depth and may show evidence of either fungal or zoogenous decomposition.

Soil Classification: mainly Orthic Humo-Ferric Podzols and Eluviated Dystric Brunisols.

Humus Form Classification: Orthimormoders; Orthihemimors.

Schematic Profile:



Horizon	Description
F	- moderately decomposed; dark brown; plentiful fine, medium roots; fungal mycelia and/or insects.
H	- well-decomposed organic horizon; black; plentiful medium, coarse roots.
Ah	- dark brown to black; silt loam; granular; abundant medium, coarse roots.
Ae	- light brownish gray; sandy loam; few medium roots; few coarse roots; acidic.
Bf	- yellowish red to brown; loamy sand; plentiful medium roots; friable.
BC	- yellowish brown; loamy to sandy; few fine roots; may be compacted with depth.

Orthic Humo-Ferric Podzol

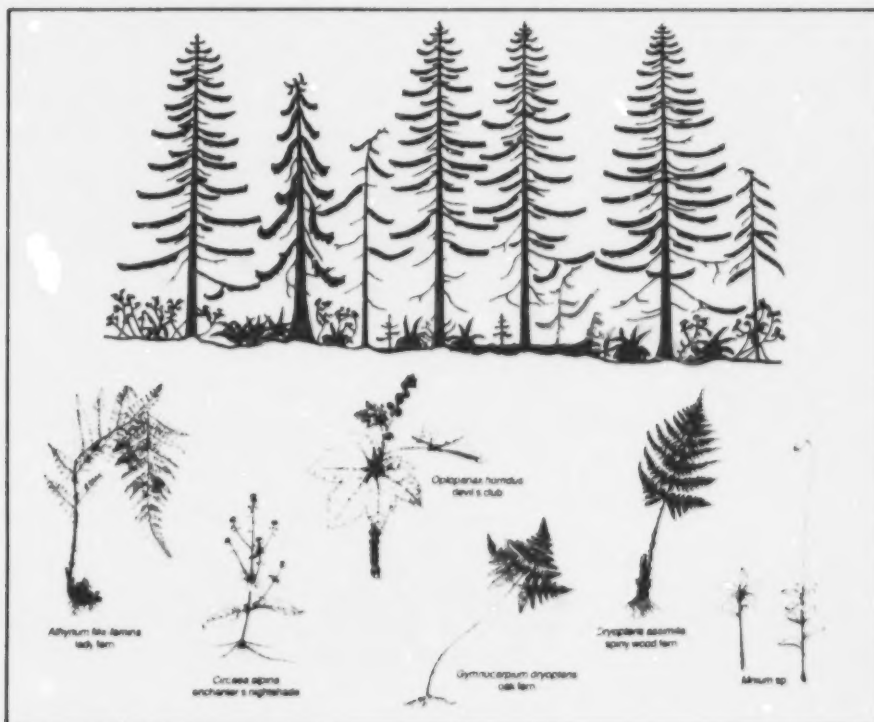
Average pH: mineral horizons - 4.5
organic horizons - 4.1

Key Characteristics:

- dominantly morainal landforms showing some signs of fluvial alteration and deposition.
- soils may be richer than mesotrophic, and generally receive more moisture than mesic sites.
- organic horizons may or may not be relatively rich depending on the site.

CWHf1: LOW ELEVATION VARIANT

/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:

subhygric - hygric

ECOLOGICAL NUTRIENT REGIME:

permesotrophic - eutrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Small pockets of this ecosystem association are found throughout the CWHf1. However, large stands occur only at low elevations along banks of major rivers and streams.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floor, toe, or lower slope bench, (gullies); positions receiving abundant seepage.

Slope range: level to gently sloping (0 - 10 (20)%).

Surface shape: straight, flat to slightly concave.

Landforms: fluvial, fluvial over morainal, washed colluvium.

CWHf1/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: large, widely spaced, often open-grown.

western hemlock	(<u>Tsuga heterophylla</u>)	
Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)	
western redcedar	(<u>Thuja plicata</u>)	
[amabilis fir	(<u>Abies amabilis</u>)]	
[black cottonwood	(<u>Populus balsamifera</u>	-seral remnants oc-
	ssp. <u>trichocarpa</u>)]	casionally present
[red alder	(<u>Alnus rubra</u>)]	-present in openings
		and young stands

Shrubs: usually dense; good vigour, especially in openings.

devil's club	(<u>Oplopanax horridus</u>)	-often totally dom-
		inates understory
salmonberry	(<u>Rubus spectabilis</u>)	-important indicator
oval-leaved blueberry	(<u>Vaccinium ovalifolium</u>)	
[currants and gooseberries	(<u>Ribes</u> spp.)]	)-important indicat-
[red-osier dogwood	(<u>Cornus sericea</u>)]	) ors but usually
[highbush-cranberry	(<u>Viburnum edule</u>)]	) suppressed by lack
[black twinberry	(<u>Lonicera involucrata</u>)]	) of light
[red elderberry	(<u>Sambucus racemosa</u>)]	)

Herbs: very well developed, many species present, excellent vigour.

lady fern	(<u>Athyrium filix-femina</u>)	-usually dominates
		herb layer
oak fern	(<u>Gymnocarpium dryopteris</u>)	-high cover, but
		hidden by lady fern
spiny wood fern	(<u>Dryopteris assimilis</u>)	
foamflowers	(<u>Tiarella trifoliata</u> ,	
	<u>T. unifoliata</u>)	
enchanter's nightshade	(<u>Circaea alpina</u>)	
stream violet	(<u>Viola glabella</u>)	
twistedstalks	(<u>Streptopus roseus</u> ,	
	<u>S. amplexifolius</u>)	
sweet-scented bedstraw	(<u>Galium triflorum</u>)	

Moss layer: sparse, covered by leaf litter, mainly on hummocks.

<u>Mnium</u> spp.		
[<u>Brachythecium</u> spp.]		
[<u>Plagiochila porelloides</u>]		
[<u>Rhytidiadelphus loreus</u>]		-dominant on
		hummocks

Remarks: This is a very productive growing site for most species of conifers.

Spruce is the largest, fastest growing tree in mature stands. There is very little advance regeneration, except on root platforms and decaying logs. The Devil's club - lady fern - oak fern ecosystem association can be distinguished from the Devil's club - oak fern ecosystem association (CWHf1/03) by the abundance of salmonberry, dominance of large ferns (lady fern and spiny wood fern) and the poorly developed moss layer dominated by leafy Mnium mosses rather than the typical weft-forming mosses.

CWHf1/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION

SOILS: These soil profiles form in lower (toe) slope positions or in local drainages where moisture is constantly received. Wet, bluish to olive gray subsurface mineral horizons are poorly aerated, often massive in structure, and contain seepage or water tables within 45 cm of the mineral surface. Abundant mottles can usually be found within 30 cm of the mineral surface. Loamy black mineral horizons (Ah) may occur in the upper 10 cm of the profile, forming above compacted layers. Organic layers range in depth from 5-15 cm and are often wet.

Soil Classification: Orthic Gleysols and Orthic Humic Gleysols.

Humus Form Classification: Orthihemihumimors and Orthimormoders.

Schematic Profile:



Horizon	Description
F	- partially decomposed organic layer; brown; abundant fine, medium roots; very moist; loose; contains fungal mycelia and/or insects.
H	- well decomposed; black; plentiful medium, coarse roots; wet.
Ah	- dark brown to black; silt loam; abundant medium, coarse, fine roots; very moist.
Bg	- dark yellowish brown; clay loam to sandy loam; few fine roots; massive to angular blocky; mottles common.
Cg	- dark gray to olive gray; sandy clay loam to clayey; poorly to moderately well drained; mottles and/or standing water common.

Orthic Gleysol

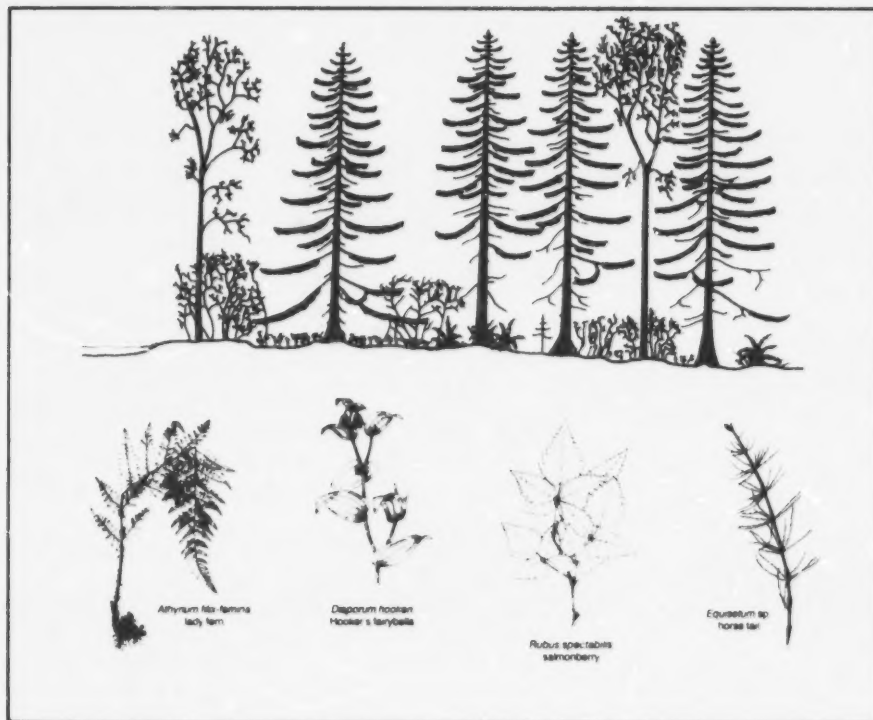
Average pH: mineral horizons - 4.6 (limited data)
organic horizons - 4.4 (limited data)

Key Characteristics:

- compacted, often saturated subsurface mineral horizons may restrict rooting to depths less than 30 cm.
- effective rooting concentrated in well-drained and well-aerated Ah and Bm horizons, and in organic layers.
- soils have abundant moisture throughout the growing season.
- organic materials hold a lot of moisture (well-decomposed layers, abundant decaying wood).
- seepage waters and/or water tables close to the surface.
- these soils develop on a variety of landforms including morainal, colluvial, and fluvial.
- frost heaving may be a problem in silty soils.

CWHf1: LOW ELEVATION VARIANT

/05 FLUVIAL SPRUCE - DEVIL'S CLUB - FERN ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:
(mesic +) - subhygric - (hygric)

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - eutrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Found in the lowlands adjacent to the Skeena and Nass rivers and their major tributaries. Very few mature examples of this ecosystem association remain.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floor.

Slope range: level (0 - 2%).

Surface shape: flat, smooth; occasionally dissected by small floodwater channels.

Landforms: recent fluvial (alluvial).

CWHF1/05 FLUVIAL SPRUCE - DEVIL'S CLUB - FERN

VEGETATION:

Trees: very large, full crown, widely spaced; canopy often broken and irregular.

Sitka or Roche spruce	(<u>Picea sitchensis</u> , <u>P. sitchensis x glauca</u>)	
[western hemlock	(<u>Tsuga heterophylla</u>)]	
[amabilis fir	(<u>Abies amabilis</u>)]	)-mostly smaller
[western redcedar	(<u>Thuja plicata</u>)]	) understory trees

Shrubs: well developed; mostly tree regeneration in tall shrub layer.

devil's club	(<u>Oplopanax horridus</u>)	-characteristic dominant
[blueberries	(<u>Vaccinium alaskaense</u> , <u>V. ovalifolium</u>)]	
[currants	(<u>Ribes spp.</u>)]	
[red elderberry	(<u>Sambucus racemosa</u>)]	
[salmonberry	(<u>Rubus spectabilis</u>)]	-in stand openings

Herbs: moderately well developed.

oak fern	(<u>Gymnocarpium dryopteris</u>)	-usually dominant; good vigour
lady fern	(<u>Athyrium filix-femina</u>)	
spiny wood fern	(<u>Dryopteris assimilis</u>)	
foamflowers	(<u>Viarella trifoliata</u> , <u>I.</u> <u>unifoliata</u>)	
twistedstalks	(<u>Streptopus amplexifolius</u> , <u>S. roseus</u>)	
[enchanter's nightshade	(<u>Circaea alpina</u>)]	
[stream violet	(<u>Viola glabella</u>)]	
[sweet-scented bedstraw	(<u>Galium triflorum</u>)]	

Moss layer: poorly developed.

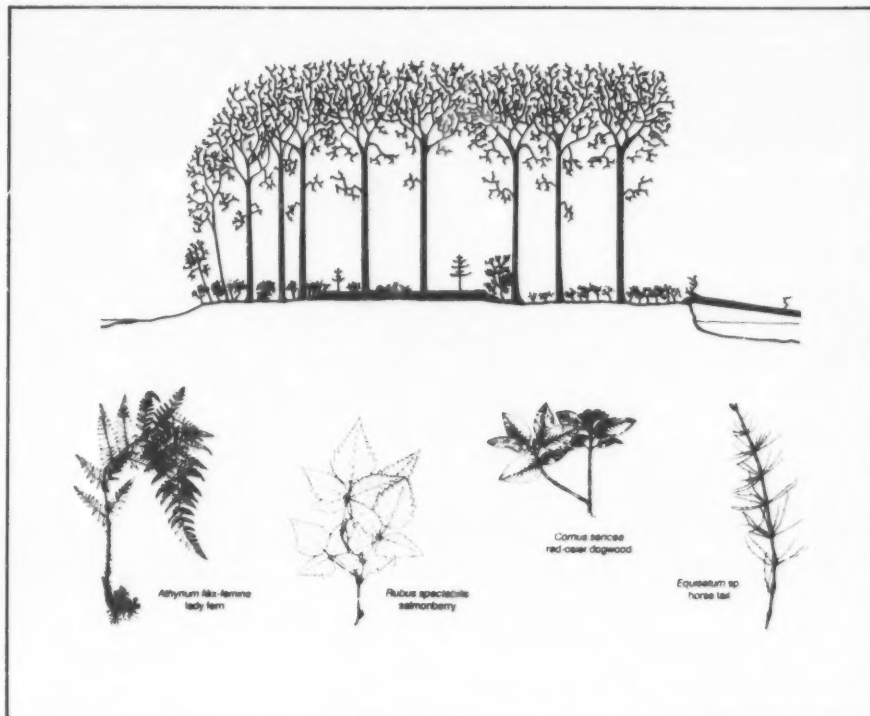
[<u>Mnium spp.</u>]		
[<u>Brachythecium spp.</u>]		
[<u>Plagiochila porelloides</u>]		
[<u>Rhytidiadelphus loreus</u>]		)-mostly on decaying
[<u>Hylocomium splendens</u>]		) logs and tree bases.

Remarks: This ecosystem association is the most productive for tree growth in the CWHf. Most productive alluvial forests have been logged or disturbed in other ways by man so that only fragments of mature stands remain. Many have reverted to cottonwood, red alder, salmonberry, and other brush.

SOILS: Refer to description under CWHf1/05(1).

CWHf1: LOW ELEVATION VARIANT

/05(1) FLUVIAL SPRUCE - DEVIL'S CLUB - FERN ECOSYSTEM ASSOCIATION:
FLOODPLAIN COTTONWOOD VARIATION



ECOLOGICAL MOISTURE REGIME:
(mesic +) - subhygric - (hygric)

ECOLOGICAL NUTRIENT REGIME:
(permesotrophic) - eutrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Abundant on the floodplains and islands of the Skeena and Nass rivers and their major tributaries. Low elevations only.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floor.

Slope range: level (0 - 2%).

Surface shape: flat, smooth; frequently dissected by small floodwater channels.

Landforms: active fluvial (alluvial floodplains).

CWHf1/05(1) FLOODPLAIN COTTONWOOD VARIATION

VEGETATION:

Trees: very large, widely spaced.

black cottonwood	(<u>Populus balsamifera</u> ssp. <u>trichocarpa</u>)	-dominant
Sitka spruce	(<u>Picea sitchensis</u>)	-scattered below
western redcedar	(<u>Thuja plicata</u>)	main tree canopy
red alder	(<u>Alnus rubra</u>)	

Shrubs: very tall, usually very dense.

red-osier dogwood	(<u>Cornus sericea</u>)
salmonberry	(<u>Rubus spectabilis</u>)
red elderberry	(<u>Sambucus racemosa</u>)
common snowberry	(<u>Symphoricarpos albus</u>)
black twinberry	(<u>Lonicera involucrata</u>)
Nootka rose	(<u>Rosa nutkana</u>)
currants	(<u>Ribes</u> spp.)
highbush-cranberry	(<u>Viburnum edule</u>)

Herbs: extremely variable; a poorly to well-developed, vigorous layer.

lady fern	(<u>Athyrium filix-femina</u>)	
horsetails	(<u>Equisetum arvense</u> , <u>E. pratense</u> , <u>E. hyemale</u>)	
Hooker's fairybells	(<u>Disporum hookeri</u>)	)
sweet-scented bedstraw	(<u>Galium triflorum</u>)	)
mountain sweet-cicely	(<u>Osmorhiza chilensis</u>)	) -excellent indicat-
false lily-of-the-valley	(<u>Maianthemum dilatatum</u>)	) ors when present
wilo sarsaparilla	(<u>Aralia nudicaulis</u>)	)
wild ginger	(<u>Asarum caudatum</u>)	)
goat's-beard	(<u>Aruncus dioicus</u>)	)
Canada violet	(<u>Viola canadensis</u>)	)
pink wintergreen	(<u>Pyrola asarifolia</u>)	)
Solomon's-seals	(<u>Smilacina</u> spp.)	)

Moss layer: generally absent, except on decaying logs and tree bases, because of heavy deciduous litterfall and flooding.

Remarks: This ecosystem unit is classified as a seral variation of the Fluvial spruce - devil's club - fern ecosystem association (CWHf1/05) because the stands of shade-intolerant black cottonwood would eventually develop into a spruce - (cedar) climax if they were removed from the

flooding zone. However, they are usually eroded away by the rivers before this succession can take place. Conifers form the advance regeneration in the stand but they are widely scattered because of intense brush competition and usually become established only on elevated microsites.

CWHf1/05(1) FLOODPLAIN COTTONWOOD VARIATION

SOILS: Two types of soils develop in floodplain areas. Included are those profiles showing little or no development (Regosols) as a result of continuous flooding, and older deposits showing brownish Brunisolic development in upper mineral horizons. Both types of soil may have a relatively high concentration of available nutrients. Active floodplain locations usually show a sequence of buried organic and mineral horizons. A dark brown mineral horizon (Ah) of silt loam texture may have formed above Bm horizons in the better developed profiles. Leafy organic materials have not accumulated to depths greater than 3 cm; insects and earthworms promote rapid decomposition.

Soil Classification: Orthic and Cumulic Regosols and Orthic Dystric and Eutric Brunisols; Orthic Humo-Ferric Podzols occasional on older floodplain.

Humus Form Classification: Orthileptomoders, Orthivelomoders, and Orthimormoders; Residuohemihumimors occasional on older floodplains.

Schematic Profile:

Horizon	Description
	L - thin leafy litter; relatively undecomposed.
	F - slightly decomposed; mineral soil may be intermixed; earthworms and insects common.
	C - grayish brown; silt to sand; plentiful medium, coarse roots; first fluvial deposit.
	Ah - very dark brown; silt loam; abundant medium, coarse roots.
	Bm - dark brown; sandy loam to silt loam; abundant medium roots; granular.
	H - buried organic horizon; well decomposed.
	IIC - dark gray; sandy; may contain mottles; second fluvial deposit.
	BC - yellowish brown; loam to sand; may contain high coarse fragment content.

Cumulic
Regosol

Orthic Eutric
Brunisol

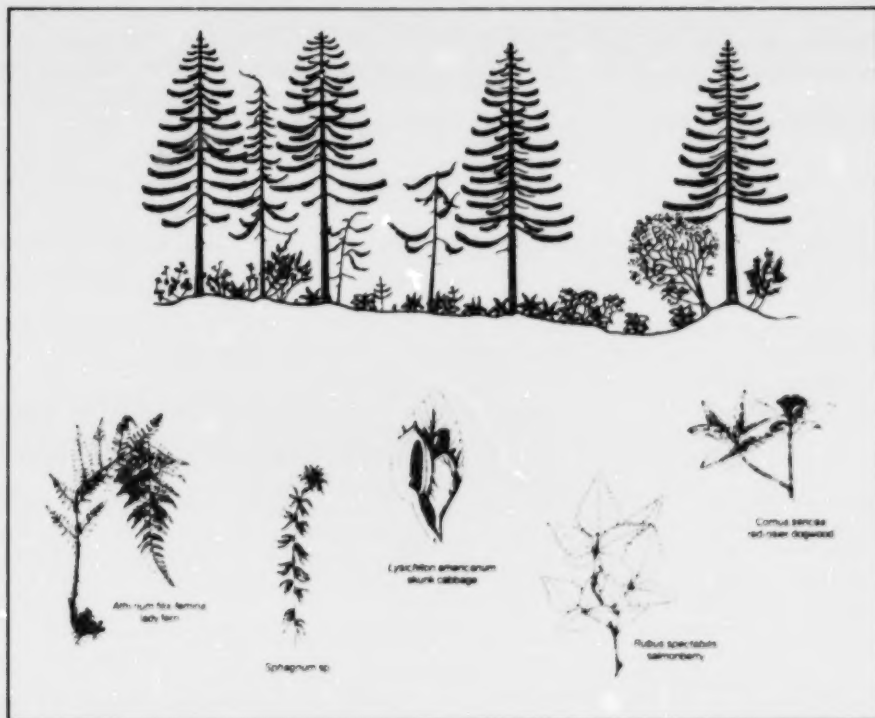
Average pH: mineral horizons - 5.3
organic horizons - 5.2

Key Characteristics:

- subject to periodic flooding.
- relatively rich soils on young alluvial deposits.
- soils have very thin organic deposits on the surface, and several organic layers may be buried.
- textures generally range from coarse sands to silts.
- in situ accumulation of organic matter in some surface mineral horizons (Ah) which aids in moisture and nutrient retention, particularly in rapidly drained, sandy soils.
- mottling may be present below 40 cm, indicating fluctuating water tables and imperfect drainage.

CWHf1: LOW ELEVATION VARIANT

/06 SKUNK CABBAGE ECOSYSTEM ASSOCIATION



	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

ECOLOGICAL MOISTURE REGIME:
(hygric +) - subhygric

ECOLOGICAL NUTRIENT REGIME:
(submesotrophic) - mesotrophic - permesotrophic +

DISTRIBUTION: Scattered in small depressions or flat areas throughout the CWHf1. Stands never of very large extent.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floor, base of slope, depressions in benches or terraces; moisture collecting positions.

Slope range: level (0 - 2%).

Surface shape: flat to concave, usually quite hummocky.

Landforms: organic over lacustrine, morainal, or fluvial deposits.

CWHF1/06 SKUNK CABBAGE ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: usually widely spaced, mostly confined to hummocks; irregular canopy.

Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)	-usually dominant, but low vigour
western hemlock	(<u>Tsuga heterophylla</u>)	-restricted to hummocks
western redcedar	(<u>Thuja plicata</u>)	-may dominate cover in some stands
[red alder	(<u>Alnus rubra</u>)]	-understory tree in stand openings

Shrubs: patchy, tall, and well developed in stand openings.

red-osier dogwood	(<u>Cornus sericea</u>)	
salmonberry	(<u>Rubus spectabilis</u>)	
highbush-cranberry	(<u>Viburnum edule</u>)	
[devil's club	(<u>Oplopanax horridus</u>)]	
[false azalea	(<u>Menziesia ferruginea</u>)]	) -on decaying wood
[blueberries/huckleberries	(<u>Vaccinium</u> spp.)]	) and hummocks
[hardhack	(<u>Spiraea douglasii</u>)]	) -good indicators
[Pacific crab apple	(<u>Malus fusca</u>)]	) when present

Herbs:

skunk cabbage	(<u>Lysichiton americanum</u>)	-characteristic dominant
lady fern	(<u>Athyrium filix-femina</u>)	
spiny wood fern	(<u>Dryopteris assimilis</u>)	
common horsetail	(<u>Equisetum arvense</u>)	
[oak fern	(<u>Gymnocarpium dryopteris</u>)]	
[foamflowers	(<u>Tiarella</u> spp.)]	
[bunchberry	(<u>Cornus canadensis</u>)]	) -common on hummocks

Moss layer: poorly developed except on hummocks.

Mnium spp.
Sphagnum spp.
Rhytidiadelphus loreus

Remarks: Swamps with skunk cabbage range from moderately poor to rich in nutrients. Skunk cabbage indicates by its abundance and vigour the ecological nutrient status of the swamp. The richest swamp ecosystems have a virtually solid cover of waist-high skunk cabbage growing in black muck. The poorest swamp ecosystems are predominantly mounds of decaying wood and other organic matter which support Rhytidiadelphus loreus, some Sphagnum, and "mesic" shrubs and herbs; small skunk cabbage plants are found in wet hollows between the mounds.

Tree growth also corresponds well with the ecological nutrient status of the swamp, although productivity is severely restricted by the high water table and poor soil aeration. The best stands are dominated by spruce (or cedar) of moderate size while the nutrient-poor swamps are dominated by nonproductive hemlock.

Variation in the character and productivity of Skunk cabbage ecosystems apparently also reflects their successional stage. Over time, productive spruce - skunk cabbage swamps gradually fill in with decayed wood and other organic matter until they support a poor Hemlock - Vaccinium - moss ecosystem elevated above the water table.

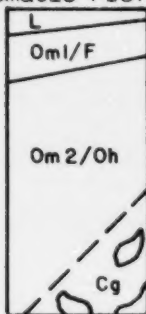
CWHf1/06 SKUNK CABBAGE ECOSYSTEM ASSOCIATION

SOILS: These soils are marginal for forest production due to permanent standing water close to the soil surface. Poorly drained, dark brown organic materials often accumulate to depths greater than 50 cm. These organic layers are very slow to decompose. Mineral materials may occur at depth and generally take on dark grayish brown colours, indicative of organic matter accumulation. Rooting cannot proceed through these lower mineral horizons because of their compacted, massive structure and saturation with water.

Soil Classification: Terric Mesisols and Humisols with minor Orthic Humic Gleysols.

Humus Form Classification: Orthihistomoders.

Schematic Profile:



Terric Mesisol
Terric Humisol

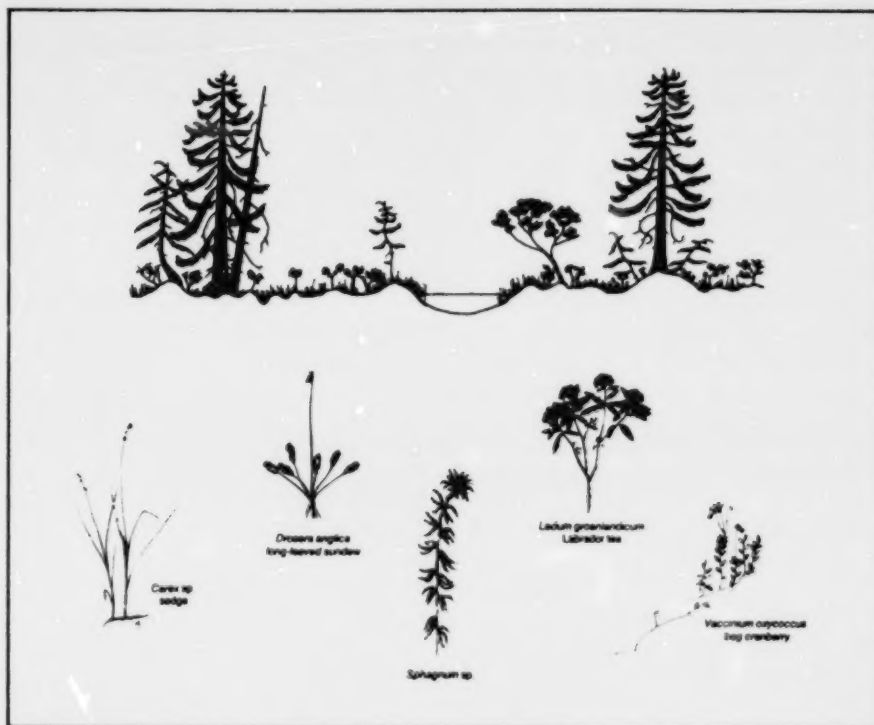
Horizon	Description
L	- undecomposed litter; little or no moss layer.
Om1/F	- slightly decomposed; well to poorly aerated; plentiful fine, medium roots; dark brown.
Om2/Oh	- moderately to well decomposed; very dark brown; poorly drained; few coarse roots; variable depth.
Cg	- dark olive gray to dark brown; sandy clay; common mottles; no roots; massive; variable depths.

Average pH: mineral horizons - 5.5 (limited data)
 organic horizons - 4.5 (limited data)

Comments: These soils form in depressions or localized drainages containing excessive water, which limits decomposition of organic materials, and allows them to accumulate. Rooting is often restricted to elevated, more freely drained hummocks and decayed wood. Mineral horizons are very compacted with few pores for free movement of water and air.

CWHf1: LOW ELEVATION VARIANT

/07 BOG ECOSYSTEMS



ECOLOGICAL MOISTURE REGIME:
(hygric +) - subhygric

ECOLOGICAL NUTRIENT REGIME:
oligotrophic - submesotrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Very limited distribution, small pockets. Bogs are found primarily in the wetter, western sections of the CWHf1.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floor, slope bases, depressions in benches and terraces; sites collecting moisture.

Slope range: level (0%), up to 10% when terraced.

Surface shape: flat, slightly concave, often terraced; many small hummocks.

Landforms: thick organic deposit.

CWHf1/07 BOG ECOSYSTEMS

VEGETATION:

Trees: scattered, open grown, very stunted, shrub-sized.

[western hemlock	(<u>Tsuga heterophylla</u>)]
[western redcedar	(<u>Thuja plicata</u>)]
[lodgepole pine	(<u>Pinus contorta</u>)]
[mountain hemlock	(<u>Tsuga mertensiana</u>)]

Shrubs:

Labrador tea	(<u>Ledum groenlandicum</u>)	-characteristic
		dominant
[hardhack	(<u>Spiraea douglasii</u>)]	
[bog blueberry	(<u>Vaccinium uliginosum</u>)]	

Herbs: cover variable, includes many dwarf-shrubs.

bog laurel	(<u>Kalmia microphylla</u>)
bog rosemary	(<u>Andromeda polifolia</u>)
bog cranberry	(<u>Vaccinium oxycoccus</u>)
sedges	(<u>Carex spp.</u>)
sundews	(<u>Drosera anglica</u> , <u>D. rotundifolia</u>)
three-leaved goldthread	(<u>Oxalis trifolia</u>)
northern starflower	(<u>Trientalis europaea ssp. arctica</u>)
white bog orchid	(<u>Platanthera dilatata</u>)
buckbean	(<u>Menyanthes trifoliata</u>)
marsh cinquefoil	(<u>Potentilla palustris</u>)
scheuchzeria	(<u>Scheuchzeria palustris</u>)
bog club-moss	(<u>Lycopodiella inundata</u>)

Moss layer: continuous, hummocky mat of peat moss.

<u>Sphagnum spp.</u>	
[<u>Aulacomnium palustre</u>]	) -on hummocks
[<u>Pleurozium schreberi</u>]	)
[<u>Hylocomium splendens</u>]	)

Remarks: The bog ecosystems are basically non-forested and have no commercial timber value. Tree growth is extremely slow under the saturated, nutrient-poor soil conditions. Unlike some other biogeoclimatic zones and subzones, the CWHf has few bogs and they are a very minor component of the landscape. Note that black spruce (Picea mariana) is absent from bogs in the CWHf, whereas it is characteristic of Interior Cedar - Hemlock (ICHg3) bogs.

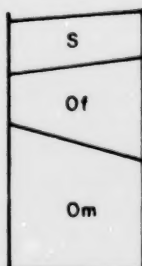
CWHf1/07 BOG ECOSYSTEMS

SOILS: Soil profiles within bogs consist of various organic layers which have accumulated to depths often greater than 100 cm. Mineral horizons are generally absent in the upper 80 cm of the profile. These organic soils exist in a primary (Of) or moderate (Om) stage of decomposition and are generally saturated with water for the entire growing season. Water tables are often within 20 cm of the soil surface.

Soil Classification*: Typic Mesisols and minor Terric Mesisols.

Humus Form Classification: Orthihistomoder.

Schematic Profile:



Horizon	Description
S	- thick sphagnum moss layer.
Of	- wet; non-freely drained; slightly decomposed; few fine, medium roots; brown.
Om	- saturated; non-freely drained; moderately decomposed; dark brown; water table present.

Typic Mesisol

Average pH: mineral horizons - 4.1 (limited data)
organic horizons - 3.6 (limited data)

Comments: These soils are wet throughout the year, with water tables often close to the surface, and productivity is low. Trafficability problems would be great in such mucky organic soils. The lack of fungal and zoogenous activity in saturated organic layers restricts decomposition rate and nutrient cycling in bog ecosystems.

* NOTE: Very limited sampling of these ecosystems.

7.3 Classification of Ecosystem Units of the CWHf2: High Elevation Variant.

/01 Zonal hemlock - (amabilis fir) - Vaccinium - moss ecosystem association

/01(1) Amabilis fir - Rhytidiopsis robusta variation

/02 Dry hemlock - moss ecosystem association

/03 Devil's club - oak fern ecosystem association

/04 Devil's club - lady fern - oak fern ecosystem association

ECOLOGICAL NUTRIENT REGIME

ECOLOGICAL MOISTURE REGIME

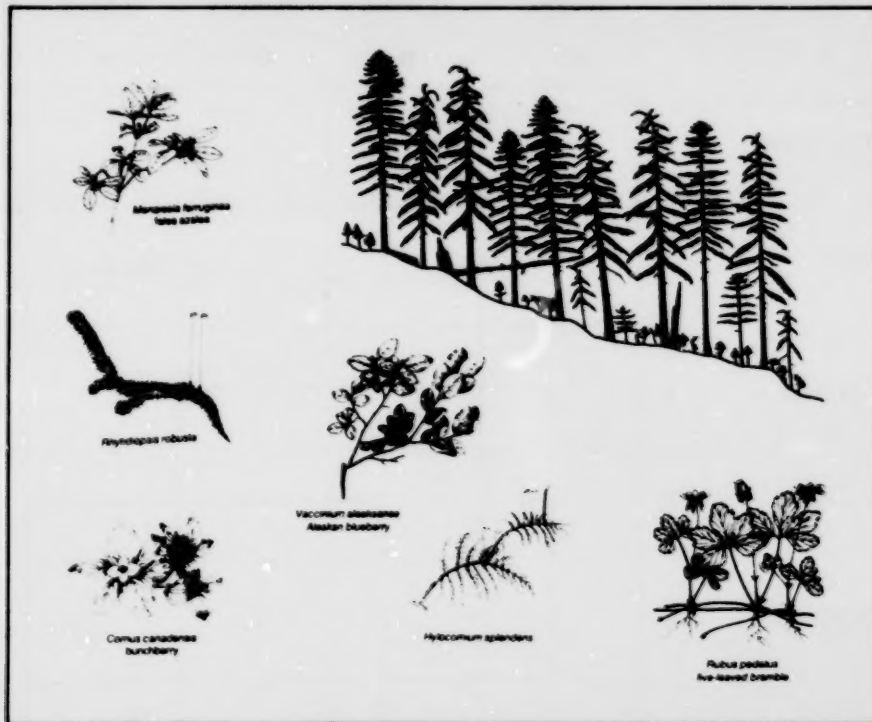
		OLIGO-TROPHIC	SUBMESO-TROPHIC	MESO-TROPHIC	PERMESO-TROPHIC	SUBEUTROPHIC TO EUTROPHIC
		A	B	C	D	E
VERY XERIC	0					
XERIC	1			Not Studied		
SUBXERIC	2					
SUBMESIC	3		2			
MESIC	4			1		
SUBHYGRIC	5				3	
HYGRIC	6					
SUBHYDRIC	7	Not Studied			4	

- 1 Zonal hemlock - (amabilis fir) - Vaccinium - moss
- 2 Dry hemlock - moss
- 3 Devil's club - oak fern
- 4 Devil's club - lady fern - oak fern

FIGURE 11. Edatopic grid of ecological moisture and nutrient regimes - CWHf2.

CWHf2: HIGH ELEVATION VARIANT

/01 ZONAL HEMLOCK - (AMABILIS FIR) - VACCINIUM - MOSS ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:
(submesic) - mesic

ECOLOGICAL NUTRIENT REGIME:
mesotrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Widespread throughout the CWHf2, covering a major portion of mountain slopes, particularly in the northwestern part of the variant.

PHYSIOGRAPHIC FEATURES:

Slope position: dominantly midslope positions, extending to upper and lower slopes; some benches.

Slope range: gentle to steep (10 - 70%+), rarely level.

Surface shape: variable; generally straight or irregular, rarely convex.

Landforms: morainal and colluvial veneers and blankets, rarely fluvium.

CWHF2/01 ZONAL HEMLOCK - (AMABILIS FIR) - VACCINIUM - MOSS ECOSYSTEM
ASSOCIATION

VEGETATION:

Trees:

western hemlock	(<u>Tsuga heterophylla</u>)	-dominant cover
amabilis fir	(<u>Abies amabilis</u>)	-usually most abundant in subcanopy

Shrubs: cover variable, usually a fairly well-developed layer, occasionally sparse to lacking.

Alaskan blueberry	(<u>Vaccinium alaskaense</u>)	-dominant shrub
false azalea	(<u>Menziesia ferruginea</u>)	
oval-leaved blueberry	(<u>Vaccinium ovalifolium</u>)	
black huckleberry	(<u>Vaccinium membranaceum</u>)	

Herbs: usually poorly developed, few species.

five-leaved bramble	(<u>Rubus pedatus</u>)
bunchberry	(<u>Cornus canadensis</u>)
one-sided wintergreen	(<u>Orthilia secunda</u>)

Moss layer: a well-developed carpet of mosses.

<u>Hylocomium splendens</u>	)-dominant cover)
<u>Rhytidiopsis robusta</u>	
<u>Rhytidiadelphus loreus</u>	
<u>Pleurozium schreberi</u>	

Remarks: This is the most common ecosystem association in the CWHF2, particularly in the northwestern portion of the variant. Amabilis fir seems to grow as well as hemlock on most sites, although it either comes in late in the development of the stand or dies earlier, and thus is found predominantly under the main canopy of hemlock. Advance regeneration is usually heavily dominated by amabilis fir. Spruce, subalpine fir, and mountain hemlock appear sporadically in these stands.

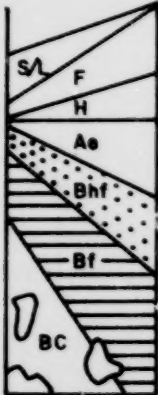
CWHF2/01 ZONAL HEMLOCK - (AMABILIS FIR) - VACCINIUM - MOSS ECOSYSTEM
ASSOCIATION

SOILS: Soil profiles develop on a variety of landforms (morainal, colluvial, glaciofluvial) receiving adequate moisture and nutrients on mid to upper slope positions. Generally yellowish brown to yellowish red podzolic development (Bf) can be seen in most profiles of this association. Soil textures are variable ranging from sands and coarse loams to clays. The coarse fragment volume within profiles is generally greater than 25%. Surface organic horizons are relatively thin ranging in depth from 3 to 13 cm.

Soil Classification: Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors, Orthihemihumimors.

Schematic Profile:

Horizon	Description
	
F	- moderately decomposed organic horizon; dark brown; common fine, medium roots; common fungal mycelia; acidic.
H	- well decomposed; black; common fine, medium, coarse roots.
Ae	- pale brown; silty clay loam; plentiful coarse roots; 15-20% coarse fragments.
Bhf	- dark reddish brown; sandy loam; plentiful, medium, coarse roots.
Bf	- dark yellowish brown to strong brown; sandy loam; few to plentiful fine, medium roots.
BC	- dark grayish-brown; sandy loam to clay loam; few roots; temporary seepage may occur.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.7
organic horizons - 3.2

Key Characteristics:

- variety of surficial materials (colluvial, morainal, glaciofluvial) of variable textures and depths.
- root-restricting layers may or may not occur within 60 cm of the mineral surface.
- temporary seepage and/or mottling may occur in subsurface mineral horizons (depths greater than 70 cm).
- surface mineral horizons (up to 50 cm) are well drained, largely because of high volume of coarse fragments and coarse textures in the upper horizons.
- surface organic layers are generally thin, but fairly well decomposed (increased moisture retention).

CWHF2: HIGH ELEVATION VARIANT

/01(1) ZONAL HEMLOCK - (AMABILIS FIR) - VACCINIUM - MOSS ECOSYSTEM
ASSOCIATION: AMABILIS FIR - RHYTIDIOPSIS ROBUSTA VARIATION



ECOLOGICAL MOISTURE REGIME:
(submesic +) - mesic

ECOLOGICAL NUTRIENT REGIME:
(submesotrophic) - mesotrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Dominantly in the southeastern part of the zone, east of the Coast Mountains, above 700 m elevation (e.g., upper Copper River drainage), but also appears in other parts of the CWHF2 where there is a heavy snowpack or continental climatic influences.

PHYSIOGRAPHIC FEATURES:

Slope position: dominantly midslope positions, extending to upper and lower slopes, benches.

Slope range: gentle to steep (10 - 70%+), rarely level.

Surface shape: variable; generally straight or irregular, rarely convex.

Landforms: morainal and colluvial blankets, (veneers).

CWHf2/01(1) AMABILIS FIR - RHYTIDIOPSIS ROBUSTA VARIATION

VEGETATION:

Trees: often rather dense with relatively small trees.

western hemlock (Tsuga heterophylla)
amabilis fir (Abies amabilis)

-always important;
frequently dominant
in cover and height

[subalpine fir (Abies lasiocarpa)]

Shrubs: very poorly developed layer, dominated by amabilis fir regeneration.

[false azalea (Menziesia ferruginea)]
[blueberry/huckleberry (Vaccinium spp.)]

Herbs: very poorly developed layer.

[five-leaved bramble (Rubus pedatus)]
[small twistedstalk (Streptopus streptopoides)]
[one-sided wintergreen (Orthilia secunda)]
[bunchberry (Cornus canadensis)]

-very characteristic

Moss layer: often noticeably compact, matted, covered by conifer twig litter.

Rhytidiopsis robusta

-characteristic
dominant

[Dicranum sp.]

Remarks: This variation of the zonal CWHf2 ecosystem association seems to reflect a cooler environment with heavy snow pack of long duration. Amabilis fir always overwhelmingly dominates advance regeneration and seems to be best adapted to the conditions. The short period of time that the ground surface is free of snow probably inhibits the establishment of understory species. Heavy snowpack compacts the moss layer and also the humus.

CWHF2/01(1) AMABILIS FIR - RHYTIDIOPSIS ROBUSTA VARIATION

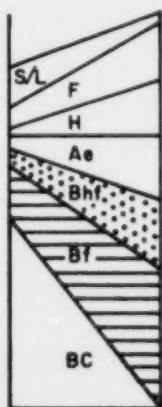
SOILS: Soil development within this phase is similar to that on zonal sites.

Generally, several soil-forming factors are important in these high elevation sites, including temperature extremes, variable precipitation and snow pack, and influences of aspect. Soils have formed dominantly on morainal and colluvial blankets and show signs of podzolic development with variable accumulation of organic matter. Light coloured to brown leached surface mineral horizons, often greater than 10 cm, may be found and indicate high rainfall and rapid drainage within upper soil horizons. Soil textures are generally loamy.

Soil Classification: Orthic Humo-Ferric and Ferro-Humic Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
S/L	- undecomposed needle litter and/or moss; loose.
F	- moderately decomposed; dark brown; compact matted; plentiful fine, medium roots.
H	- well decomposed; black; plentiful medium, coarse roots.
Ae	- pale brown; loam; plentiful fine, medium roots; very acidic.
Bhf	- dark reddish brown; horizon enriched in organic matter.
Bf	- dark reddish brown; loamy; abundant medium, coarse roots.
BC	- yellowish brown; sandy loam to clay loam.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.3
organic horizons - 3.2

Key Characteristics:

- most profiles show podzolic development with some accumulation of organic matter in surface mineral horizons (Bhf).
- leached, light coloured Ae horizons are common, very acidic, and may be streaked in appearance, suggesting movement of organic matter in surface horizons.
- organic horizons vary in depth from 5-17 cm, and commonly contain a matted fungal layer.
- root-restricting layers are lacking.
- wet profiles with seepage and/or mottling are absent.

CWHF2: HIGH ELEVATION VARIANT

/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

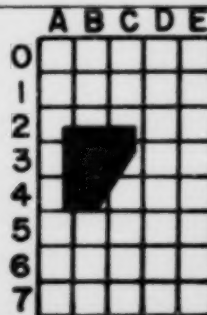


ECOLOGICAL MOISTURE REGIME:

(subxeric) - submesic - (mesic -)

ECOLOGICAL NUTRIENT REGIME:

submesotrophic - (mesotrophic)



DISTRIBUTION: Distributed throughout the CWHF2 although only occupying a minor part of the landscape. Its extent is especially limited in wetter, western portions of the variant, where it occurs only on the most extreme sites.

PHYSIOGRAPHIC FEATURES:

Slope position: upper slopes, ridges, bedrock outcrops, benches (river terraces).

Slope range: level to extremely steep.

Surface shape: convex, straight to flat.

Landforms: shallow morainal (colluvial) veneers over bedrock; rarely coarse-textured fluvium or glaciofluvial material.

CWHF2/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: usually small, short; stands often dense.

western hemlock (Tsuga heterophylla)

[amabilis fir (Abies amabilis)]

[subalpine fir (Abies lasiocarpa)]

-dominant

-common under main canopy

-scattered individuals common

Shrubs: a very poorly developed layer.

[Alaskan blueberry (Vaccinium alaskaense)]

[false azalea (Menziesia ferruginea)]

[oval-leaved blueberry (Vaccinium ovalifolium)]

Herbs: a very poorly developed layer.

[one-sided wintergreen (Orthilia secunda)]

[five-leaved bramble (Rubus pedatus)]

[bunchberry (Cornus canadensis)]

Moss layer: usually a well-developed carpet of feathermosses.

Hylocomium splendens

Pleurozium schreberi

Rhytidiopsis robusta

Remarks: The Dry hemlock - moss ecosystem association has a much more limited distribution in the CWHF2 than in the CWHF1 because heavier snowpacks and a cooler, more humid environment at the high elevations prevent most sites from drying out. Soils must be extremely shallow or well drained and/or the site must be exposed to above-average sunlight for this ecosystem association to develop in the high elevation variant.

Advance regeneration in these stands is generally sparse and dominated by amabilis fir. However, amabilis fir rarely reaches the main canopy and grows very slowly. Dominance of western hemlock, generally poor tree growth, and predominance of Hylocomium splendens and Pleurozium schreberi over Rhytidiopsis robusta distinguish this ecosystem association from the moss variation of the Zonal hemlock - Vaccinium - moss ecosystem association.

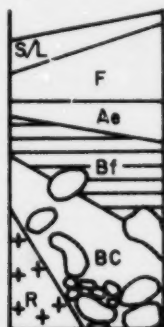
CWHf2/02 DRY HEMLOCK - MOSS ECOSYSTEM ASSOCIATION

SOILS: Soil profiles have developed primarily on morainal veneers overlying bedrock and coarse-textured fluvial landforms. These soils are rapidly drained, and have a significant volume of coarse fragments. Pale brown to white leached mineral horizons (often thicker than 4 cm) are found at the mineral surface. These horizons are underlain by podzolic Bf horizons of loamy sand texture and strong brown to yellowish red colour. Subsurface mineral horizons (BC) are coarse textured and often intruded by bedrock within 50 cm of the mineral surface.

Soil Classification: Orthic Humo-Ferric Podzols.

Humus Form Classification: Orthihemimors.

Schematic Profile:



Horizon	Description
F	- slightly to moderately decomposed; dark brown; plentiful fine, medium, coarse roots; common white mycelia; very acidic.
Ae	- pale brown; silt loam to sandy loam; plentiful fine roots; acidic.
Bf	- dark yellowish brown; loamy sand; abundant medium, coarse roots; single grain.
BC	- yellowish brown; sand; few fine, medium roots; high coarse fragment content; bedrock beneath.

Orthic Humo-Ferric Podzol

Average pH: mineral horizons - 4.4
organic horizons - 3.0

Key Characteristics:

- shallow soils common; bedrock often within 50 cm of mineral surface.
- coarse textured, rapidly drained soils of high coarse fragment content.
- moderately thick organic materials (8-15 cm) on these dry sites.
- very acidic organic materials.
- effective rooting generally to bedrock.

Comments: The rapidly drained, shallow soils suggest that this dry ecosystem association has a strong tendency toward water and nutrient losses as well as erosion. Organic materials have accumulated to depths often greater than 10 cm, which may allow greater leeway in site manipulation as compared to other dry ecosystems.

CWHf2: HIGH ELEVATION VARIANT

/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:
subhygric

ECOLOGICAL NUTRIENT REGIME:
mesotrophic - permesotrophic

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Found throughout the CWHf2, very common but usually not extensive.

PHYSIOGRAPHIC FEATURES:

Slope position: middle - lower slopes, minor snowmelt pockets, and drainages, (valley floors); sites receiving seepage.

Slope range: flat to very steep, but usually gently sloping.

Surface shape: concave - straight.

Landforms: washed morainal or colluvial, glaciofluvial materials.

CWHF2/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees:

western hemlock	(<u>Tsuga heterophylla</u>)	
amabilis fir	(<u>Abies amabilis</u>)	
[subalpine fir	(<u>Abies lasiocarpa</u>)	
[Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)	-infrequent but grows well

Shrubs: a moderately to well-developed layer.

devil's club	(<u>Oplopanax horridus</u>)	-always present, not always dominant
oval-leaved blueberry	(<u>Vaccinium ovalifolium</u>)	
Alaskan blueberry	(<u>Vaccinium alaskaense</u>)	
black huckleberry	(<u>Vaccinium membranaceum</u>)	
false azalea	(<u>Menziesia ferruginea</u>)	
black gooseberry	(<u>Ribes lacustre</u>)	
salmonberry	(<u>Rubus spectabilis</u>)	

Herbs: a moderately to well-developed layer.

oak fern	(<u>Gymnocarpium dryopteris</u>)	-characteristic dominant
foamflowers	(<u>Tiarella unifoliata</u> , <u>T. trifoliata</u>)	
twistedstalks	(<u>Streptopus streptopoides</u> , <u>S. roseus</u> , <u>S. amplexifolius</u>)	
five-leaved bramble	(<u>Rubus pedatus</u>)	-not good indicator, but very common, good vigour
bunchberry	(<u>Cornus canadensis</u>)	
[spiny wood fern	(<u>Dryopteris assimilis</u>)	

Moss layer: usually a well-developed layer; composition variable.

<u>Rhytidiopsis robusta</u>	
<u>Rhytidiadelphus loreus</u>	
<u>Hylocomium splendens</u>	
<u>Pleurozium schreberi</u>	
<u>Mnium</u> spp.	-mainly in depressions and pockets

Remarks: This is a productive ecosystem association for hemlock, amabilis fir and spruce. Devil's club is common and conspicuous but rarely does it totally dominate the shrub layer. Instead it usually occurs in mixture with Vaccinium spp. and false azalea. Depressional microsites within the Devil's club - oak fern e.a. may often be wetter and contain indicator species from the Devil's club - lady fern - oak fern e.a. (CWHf2/04).

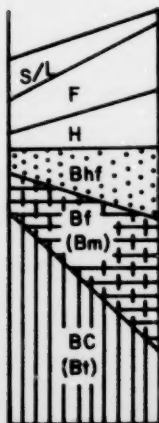
CWHF2/03 DEVIL'S CLUB - OAK FERN ECOSYSTEM ASSOCIATION

SOILS: Sampling of this ecosystem association was very limited. However, it is evident that these soils receive more moisture and nutrients than mesic sites. Soil profiles often show an accumulation of organic matter within surface mineral horizons (Bhf), resulting in dark brown coloration. Yellowish brown to grayish brown subsurface mineral horizons have a low coarse fragment content and variable textures. Periodic seepage may occur within the rooting zone. Organic horizons are moderately well decomposed and may show an increase in zoogenous (insect) activity, resulting in loose, granular structure.

Soil Classification: Orthic Ferro-Humic Podzols; Brunisolic Gray Luvisols.

Humus Form Classification: Orthimormoders; Orthihemihumors.

Schematic Profile:



Horizon

Description

- | | |
|---------|---|
| S/L | - loose, undecomposed, litter and/or moss layer. |
| F | - moderately decomposed; dark brown; plentiful fine, medium roots; presence of white fungal mycelia and/or zoogenous activity. |
| H | - well decomposed; black; abundant medium, coarse roots. |
| Bhf | - dark reddish brown; loam; abundant medium, coarse roots. |
| Bf (Bm) | - yellow brown to brown; sandy loam; plentiful medium, fine roots. |
| BC (Bt) | - grayish brown; loamy sand to clay loam; single grain to angular blocky; few to plentiful fine roots; clay skins may or may not occur; low coarse fragment volume. |

Orthic Ferro-Humic Podzol
(Brunisolic Gray Luvisol)

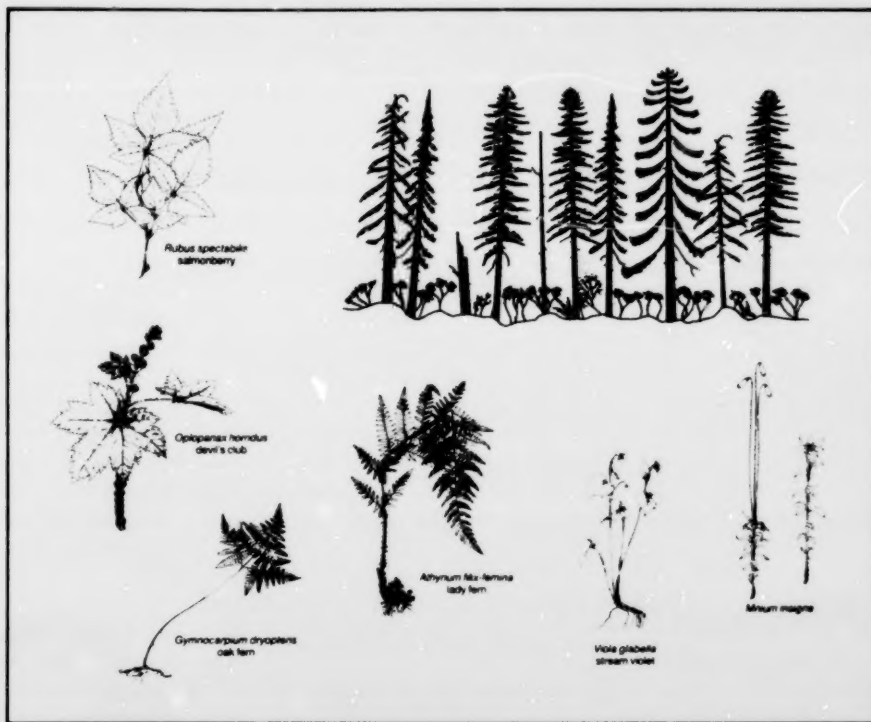
Average pH: mineral horizons - 5.0
organic horizons - 4.3

Key Characteristics:

- both well and moderately drained soils in receiving slope positions have adequate to abundant moisture for most of the growing season.
- dark brown surface mineral horizons show an accumulation of organic matter (Ah, Bhf) and usually support abundant rooting.
- these moist sites support greater numbers of decomposing insects in organic horizons.
- organic materials are moderately well decomposed and have above-average nutrient status.

CWHF2: HIGH ELEVATION VARIANT

/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION



ECOLOGICAL MOISTURE REGIME:
(subhygric +) - hygric

ECOLOGICAL NUTRIENT REGIME:
permesotrophic - (eutrophic)

	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					

DISTRIBUTION: Small pockets of this ecosystem association are found on mountain sides throughout the CWHF2. Large stands are uncommon and restricted to the wider valleys found within the high elevation variant.

PHYSIOGRAPHIC FEATURES:

Slope position: valley floor, lower slope and toe, gullies and drainage channels; sites receiving abundant moisture.

Slope range: level to moderately sloping, usually gentle (0 - 25%).

Surface shape: concave - straight.

Landforms: fluvial, some washed moraine and colluvium.

CWHF2/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION

VEGETATION:

Trees: composition variable; trees large for CWHF2, open spacing.

western hemlock	(<u>Tsuga heterophylla</u>)	
amabilis fir	(<u>Abies amabilis</u>)	
subalpine fir	(<u>Abies lasiocarpa</u>)	-esp. in cold air drainages
[Roche spruce	(<u>Picea sitchensis</u> x <u>glauca</u>)]	-largest tree when present

Shrubs: generally well-developed layer, especially in stand openings.

devil's club	(<u>Oplopanax horridus</u>)	-characteristic dominant shrub
salmonberry	(<u>Rubus spectabilis</u>)	)-consistently
black gooseberry	(<u>Ribes lacustre</u>)	) present
blueberry/huckleberry	(<u>Vaccinium</u> spp.)	-confined to decaying wood
thimbleberry	(<u>Rubus parviflorus</u>)	-common in eastern sections
red elderberry	(<u>Sambucus racemosa</u>)	-occurs primarily in stand openings

Herbs: a well-developed layer; diverse species composition.

lady fern	(<u>Athyrium filix femina</u>)	-visually dominates herb layer
oak fern	(<u>Gymnocarpium dryopteris</u>)	-heavy cover, often obscured by taller species
foamflowers	(<u>Tiarella trifoliata</u> , <u>T. unifoliata</u>)	
stream violet	(<u>Viola glabella</u>)	
twistedstalks	(<u>Streptopus streptopoides</u> , <u>S. roseus</u> , <u>S. amplexifolius</u>)	
[common horsetail	(<u>Equisetum arvense</u>)]	
[sweet-scented bedstraw	(<u>Galium triflorum</u>)]	
[spiny wood fern	(<u>Dryopteris assimilis</u>)]	
[Indian hellebore	(<u>Veratrum viride</u>)]	-characteristic
[Sitka valerian	(<u>Valeriana sitchensis</u>)]	) high-elevation, wet-site species, upper elevations only

Moss layer: usually poorly developed; mainly on elevated mounds and decaying wood.

Mnium spp.		-dominant
[<u>Brachythecium</u> spp.]		
[<u>Rhytidiopsis robusta</u>]		-on decaying wood and mounds

Remarks: This is the most productive ecosystem association in the CWHf2. Small patches of it develop wherever drainage channels occur; however, extensive stands are rare. All the tree species occurring in the variant grow well here, although hemlock growth may be restricted on all but the best drained microsites. Spruce appears to grow best of all, but rarely is a major component of any stand. Subalpine fir in the CWHf2 tends to concentrate in drainages belonging to this ecosystem unit. It often reaches an appreciable size, but seems to die off at an early age. Advance regeneration is sporadic and found mainly on decaying wood and upturned roots.

CWHf2/04 DEVIL'S CLUB - LADY FERN - OAK FERN ECOSYSTEM ASSOCIATION

SOILS: These soils represent some of the most productive sites within the CWHf2 variant, and vigorous vegetation usually reflects this. Seepage waters or water tables can often be found within 50 cm of the mineral surface. Dark brown surface mineral horizons (Ah) of loam to silt loam texture often form in these soils. Although wet, mottled subsurface mineral horizons are most common in these receiving sites, better drained soils may also occur. Relatively deep organic layers (12-28 cm) can accumulate and persist in an advanced stage of decomposition (H horizon dominating).

Soil Classification: Orthic Eutric Brunisols; Orthic Humic Gleysols; Gleyed Ferro-Humic Podzols.

Humus Form Classification: Orthihumimors; Lignomormoders.

Schematic Profile:

Horizon	Description
S/L	
F	- moderately decomposed; dark brown; abundant fine, medium roots; contains fungal mycelia and/or insects.
H	- well decomposed; black; abundant medium, coarse roots.
Ah	- dark brown to black; silt loam; granular; plentiful fine, medium roots.
Bm (Bg)	- dark brown; silt loam to loam; plentiful medium roots; granular to massive; may contain mottles (Bg) and/or seepage.
BC (Cg)	- massive; loamy sand to clay; wet; mottling may occur; water tables common.

Orthic Eutric Brunisol
(Orthic Humic Gleysol)

Average pH: mineral horizons - 5.9
organic horizons - 5.7

Key Characteristics:

- soils either in receiving positions (abundant seepage) or on young alluvial deposits that may contain a good supply of nutrients.
- surface mineral horizons often very moist and with dark brown colours indicative of humus accumulation in mineral soil (Ah, Bhf, Bm).
- water tables and/or seepage quite common on morainal landforms within 60 cm of the mineral surface.
- subsurface mineral horizons, of fine texture, may be compacted and root-restricting.
- higher pH (more basic) values common in mineral horizons.
- thick accumulation of surface organic materials, often rich, well decomposed and with a high capacity to retain moisture.

CWHf2: HIGH ELEVATION VARIANT

Other Ecosystem Units:

The extent of ecological sampling within the high elevation variant of the CWHf is limited, primarily because of lack of access. The ecosystem units we have described are by no means comprehensive, although they do represent the most common and commercially most important forests in the CWHf2. We have not described, for example, a swampy skunk cabbage ecosystem association or any bog ecosystems. Both can certainly be found within the CWHf2; however, their distribution and importance are limited. We also expect to find few, if any, significant examples of alluvial spruce or cottonwood ecosystems at higher elevations.

If you encounter an ecosystem association that has not been described in this section, please refer to corresponding or similar descriptions and interpretations of CWHf1 ecosystem units. Keep in mind the effect that increasing elevation has on the ecology and distribution of a species (e.g., no western redcedar), and adjust the prescription to account for special problems associated with high elevation forest management.

8 SILVICULTURAL MANAGEMENT INTERPRETATIONS

8.1 Introduction

Ecological classification provides an excellent basis for developing management prescriptions. The use of this classification, for example in the implementation of silvicultural prescriptions, will improve forest management. Figure 12 shows the relationship between the processes of classification, interpretation, and stand management and their respective products: ecosystem units, silvicultural prescriptions, and "productive" forests. Stand management proceeds with the implementation of the silvicultural prescriptions or, if required, with the modification of them to accommodate other management concerns such as protection or logging constraints. These other concerns alone must not determine actual stand and forest management. The silvicultural prescription should provide the direction and the guidance to satisfy all concerns without compromising good forest management.

The prescriptions of this guide were developed by:

- i) compiling local experience (A. Kokoshke, D. Annas, J. Standish, A. Waters, Forest Service staff of Terrace and Hazelton Districts). Individuals who had made their own interpretations were interviewed and had their work reviewed. Their conclusions and recommendations were then edited and incorporated into this guide.
- ii) examining past practices. Over 50 individual ecosystem units were examined in the fall of 1980 to assess the effects of present logging methods, site preparation techniques, and reforestation practices.
- iii) reviewing the literature. Much of the relevant literature was reviewed to substantiate the prescriptions. We used only those articles we thought were pertinent to this subzone.

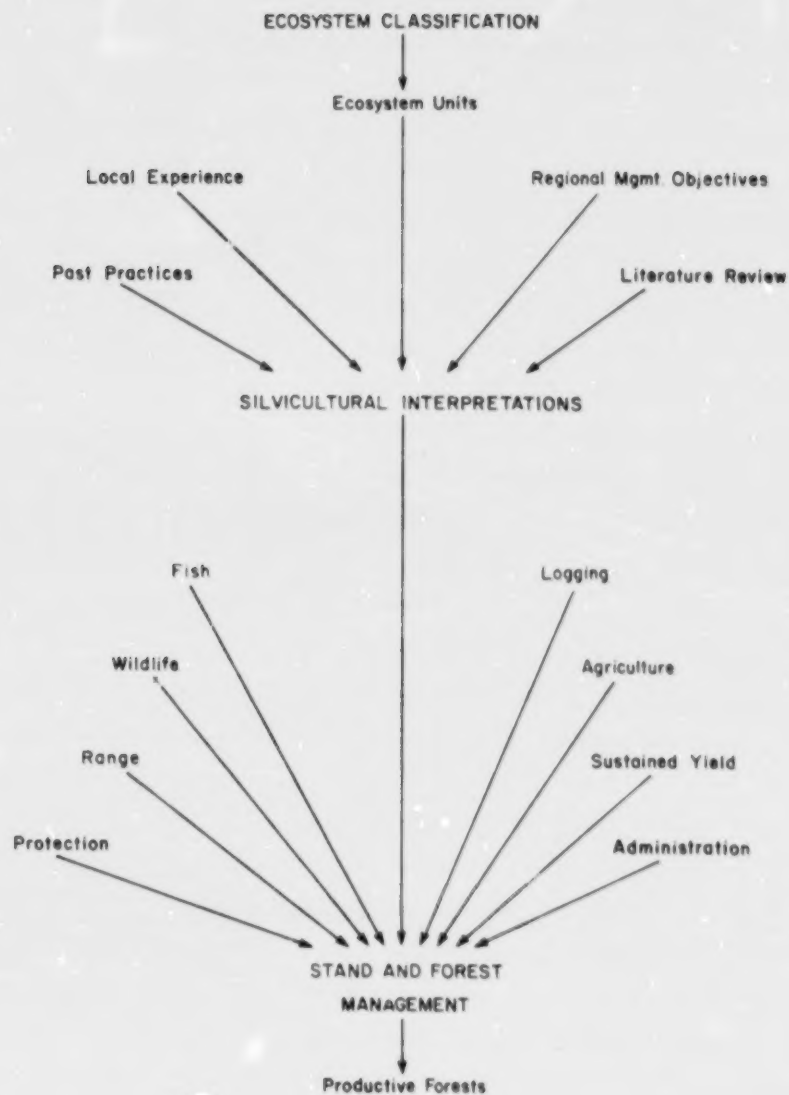


FIGURE 12. The relationship between classification, prescription, and management.

iii) considering the management objectives of the Prince Rupert Forest Region. These objectives include:

- to maintain or improve site
- to produce sawlogs
- to ensure "free growing" stands with suitable species and acceptable stocking
- to achieve an average rotation age of 80 years
- to space all suitable stands

This interpretive part of the guide is an attempt to summarize past silvicultural practices and standardize future establishment efforts in the CWHf. As we learn more, it is anticipated that not only will silvicultural prescriptions improve and broaden, but also more kinds of prescriptions will be added, such as those that involve forest protection, range, recreation, fish, and wildlife considerations. Those who apply the following information must pass on their experiences -- constructive criticism, new information, and suggestions -- so that future revisions and additions will reflect their findings.

Section 8.2 of this interpretive material discusses management activities that occur in the CWHf, while Section 8.3 presents specific prescriptions for each ecosystem unit. Both sections are initially required to give users a full appreciation of the prescriptions and their usefulness. We refer the reader to the literature cited for additional clarification. However, for quick reference and field guidance, Section 8.3 will provide sufficient information dealing with individual cut blocks.

8.2 Management Considerations For The CWHf

This section discusses early stand management activities without referring to specific ecosystem units. These activities will be dealt with in the "normal" chronological order of logging, site preparation, reforestation, and control of insects and disease, although in practice two or three activities often occur simultaneously.

8.2.1 Logging

Logging activities (falling, yarding, and hauling), along with the prerequisite layout and scheduling, rarely are seriously viewed in our forest region as methods of site preparation and reforestation. There are, however, many times when they could be modified for those purposes. In so doing, logging could benefit total stand management without incurring significant additional costs. Consider the following:

i) Regeneration systems

The dominant logging method in the CWHf is clearcutting and high-lead yarding. However, other logging methods may be preferable on some sites. For example, on ecosystems that are very difficult to regenerate (specifically by planting) without causing site degradation (e.g., some ecosystems of the CWHf1/02: Dry Hemlock - Moss), a diameter-cut or selective system with skidder yarding may be the preferred alternative (Jerry Franklin, personal communication, 1981). This, of course, assumes a suitable logging chance as well as an acceptable residual stand (in terms of species, age, logging damage, etc.).

ii) Layout and scheduling

Logging can often make subsequent management activities much easier and more successful. For example, instead of including ecosystem units that range from very dry to very brushy in one opening, two openings could be made (or one opening split by a year of logging). The brushy areas could be logged, burned, and planted before treating the other, drier areas, which should not be burned. Ideally openings that have extreme brush potential should be scheduled so that falling, yarding, hauling, salvage, site preparation, and planting all occur in one year. With current manpower and man-day allocations this is very difficult. The only acceptable alternative is to immediately provide compensating activities,

in particular brushing and weeding and/or cleaning and/or fill-planting of failed plantations, and/or release as well as repeat treatments.

iii) Advanced regeneration

Protecting acceptable advanced regeneration at the harvesting stage can save significant amounts of time, effort, and money in establishing the next crop. For a more detailed discussion see Section 8.2.2.1.

iv) Slash

Forest managers can reduce slash problems (breakage, fire hazard, poor planter access, poor distribution of seedlings) by modifying the logging of an opening (Ruth and Harris 1975).

Several methods are available:

- improved utilization: smaller top diameters, lower stumps, using shorter and more defective chunks, careful felling and bucking, extracting all species;
- improved planning: better deflection, uphill over downhill yarding;
- relogging: improved salvage operations, specialty products (shakes, posts);
- prelogging: first logging small trees that might otherwise be broken;
- Y.U.M.: Yarding Unutilized Material.

Economic conditions in the past have often resulted in relaxation of standards so that slash was dramatically increased. Managers must then be prepared to increase post-logging management efforts at a later date.

v) Productive area (Schwab 1978¹; Schwab and Watt 1981; Smith and Wass 1979, 1980)

¹ J.W. Schwab. 1978. Soil disturbance associated with tractor skidding, access logging, and high yield yarding in the Prince Rupert Forest District. B.C. Min. For., Smithers, B.C. Unpublished report.

The running surface of landings and major skid trails often do not regenerate satisfactorily. Even though they may appear acceptably stocked through planting or natural seeding, the resulting trees are generally of much poorer quality (height and colour) than those of the opening. Landings and roads, particularly skidder "shows", have removed a significant amount (up to 50% [H.I. Hammond, personal communication, 1981]) of some openings from production by removing and/or compacting soil horizons. To reduce this problem, design and schedule openings to reduce the number and size of landings and major haul roads¹.

Road building and logging increase the risk of erosion. Those erosion features that may result in the loss of an area for at least the next rotation include debris slides, debris avalanches and flows, slump earthflows, gullyng, and debris torrents. Addressing these potential problems at the planning and layout stage often reduces the risk of severe erosion.

8.2.2 Site preparation

Site preparation traditionally is the first management activity that focuses on silviculture: the control of the establishment, growth, and composition of the future stand. Methods of site preparation have often doubled as methods of protection (fire hazard abatement and pathological control), with the two types of treatment differing only in their objectives. This discussion will not consider methods as such, but instead will examine issues that need to be addressed before a site preparation plan is formulated. These issues involve advanced regeneration, prescribed fire, and brush potential.

¹ H.L. Hammond. 1982. Ground skidding handbook for the Nelson Forest District. Nelson, B.C. Unpublished report.

8.2.2.1 Advanced regeneration

The utilization of acceptable regeneration can reduce the rotation up to 10 years (normally 2 or 3 years). The acceptability of advanced regeneration depends on a species' suitability for the site and on seedling density, distribution, and quality.

i) Suitable species:

Hemlock and amabilis fir are the dominant advanced regeneration in the CWHf. On all but the driest (submesic and drier) and wettest (hydryic) ecosystem units, hemlock is a suitable species. (Be careful of stands with heavy mistletoe infestation.) Amabilis fir, on the other hand, is suitable only on the mesic, subhygric, and hygric sites (K. Klinka. Letter to J. Harwijne, Crown Zellerbach Canada, Ltd., 1977). There is a possibility that advanced amabilis fir may slow down after 10 years or so on mesic sites with warmer, drier exposure and/or with thick Mor humus and lots of decaying wood. This might occur because of increased decomposition of organic matter after clearcutting, a resultant increase in carbon: nitrogen ratio of the soil, and reduced availability of nitrogen for trees. Juvenile spacing could solve such a problem by removing the poorly growing individuals.

ii) Density/Distribution:

How (methods, skill), when (season, weather), and what (utilization, "3-m knockdown") one harvests affect the density and distribution of advanced regeneration. Occasionally as much as 2/3 of the regeneration are destroyed by harvesting activities (Herring and Etheridge 1976; Herring 1977, 1979). However, through careful harvesting (particularly "winter" logging where advanced regeneration is protected under snow) this can be

substantially reduced (Smith and Wass 1979). A detailed regeneration survey is required when including advanced regeneration as a component of the next stand.

iii) Quality:

How, when, and what one harvests also affect the quality of the remaining advanced regeneration. However, acceptable quality is more difficult to determine than acceptable density and distribution. In general, taller advanced regeneration suffers more damage and is the least capable of healing itself quickly (Herring and Etheridge 1976; Gravelle 1977; Smith and Wass 1979; Antos and Shearer 1980; Ferguson and Adams 1980). The literature suggests a 1.5-3.0 m tree should be the cut-off between acceptable and unacceptable. These studies, however do not apply specifically to the clearcutting and yarding techniques of the CWHf. A 0.5 m tree seems to be a more suitable cut-off¹ in the CWHf:

less than 0.5 m - for drier sites (shock and stress)

- anticipating abnormally severe drying periods (summer or winter)
- for reconnaissance type regeneration surveys

greater than 0.5 m - winter logging

- careful logging
- if trees are examined closely during regeneration surveys

¹ W.H. van Heek. 1966. Assessment of regeneration in Tree-Farm licence Number 1. Vancouver, B.C. Unpublished thesis for registration in the Association of B.C. Professional Foresters.

Stand structure and site conditions can also affect quality. In old decadent uneven-aged stands on rough terrain, breakage and yarding difficulties may cause more damage to advanced regeneration than in younger, good quality, even-aged stands on easy terrain.

In marginally stocked situations (+/- 51%) some poor quality advanced regeneration may become acceptable when the alternative is more undesirable (e.g., burning heavy slash, imminent brush problems, high risk artificial regeneration).

For a useful guide as to what is acceptable quality and what is not, refer to Gravelle (1977) for hemlock; and for amabilis fir, to "Regeneration Survey Standards for Advanced Amabilis Fir in the Vancouver Forest District", by the Vancouver District Reforestation Staff ([1977] 15 p.)

Guidance from the literature with respect to cedar is lacking. However, cedar seems to suffer similar damage to hemlock and amabilis fir, but likely is more resistant to rot. We therefore suggest using the same guide above.

Pine and spruce are rare as advanced regeneration in the CWHf.

8.2.2.2 Prescribed burning

Fire is prescribed for a number of benefits. In the CWHf these include:

- i) site preparation - brush retardation, species conversion, stocking control, planting ease;
- ii) protection - hazard abatement, pathological control.

These benefits are well known because they are immediately and obviously available. They weigh heavily in decision-making processes that include fire as an alternative. Drawbacks, excluding escaped burns and some disease and insect problems, likely manifest themselves much later, are not as well known or

substantiated, and therefore weigh relatively little in those decisions. These drawbacks mainly concern losses in future productivity and include chemical, physical, and biological changes in the soil. For a complete discussion based on an extensive literature review see Macadam (1981)¹ and Feller (1982).

Early indications of the long-term effects of fire (Czapowskyj et al. 1977; Kraemer and Herman 1979; McMinin 1979) suggest that it is often possible to burn without causing significant site degradation. However, the burn must be intelligently prescribed and properly implemented (e.g., Chrosciewicz 1967, 1978 a, b; Martin 1976). Burning on "riskier" sites (drier, southern aspects, heavier slash, higher coarse fragment content, higher brush potential) requires an appropriate change in emphases (for compensating activities, see Section 8.2.1) to avoid plantation failures. In particular, it requires more precise and detailed planning, closer supervision, and less tolerance or flexibility in implementation (regarding quality of stock, stock handling, planting quality, and scheduling). If that change in emphasis cannot be guaranteed, then burning should not be done. Some sites, however, should not be burned under any circumstances: dry (submesic and drier) sites with thin organic horizons (less than 5 cm); steep slopes subject to erosion; and areas unplantable due to soil conditions (such as large amounts of coarse fragments).

¹ A. Macadam. 1981. Effects of prescribed fire on forest soils in the Prince Rupert Forest Region. An interim report. B.C. Min. For., Smithers, B.C. Unpublished manuscript.

8.2.2.3 Brush¹

Brush potential is a function of the ecosystem, the abundance (and sometimes vigour) of brush species (see Table 5) before harvesting, and the amount of logging disturbance (Zasada and Grigal 1978). The prescriptions which follow (in Section 8.3) designate the brush potential of each ecosystem unit as either low, medium, or high. These ratings can also be determined by considering criteria listed in Table 6. High brush potential areas are not difficult to identify before they become a problem and must be scheduled in advance of logging, for prompt reforestation (AS PRIORITY) with appropriate contingency plans and frequent follow up. Typically the most productive ecosystems also have the highest brush potential. Once brush has taken control, reclamation is neither easy nor cheap.

8.2.2.4 Other considerations

i) natural regeneration

In the CWHf, post-logging seeding-in is dominated by western hemlock. However, the species is as yet too unpredictable and often too sparse to stock an opening acceptably by itself². The combination of seeding-in plus healthy advanced regeneration (of both western hemlock and amabilis fir) is often sufficient to stock most sites.

¹ Deciduous trees, shrubs, and herbs that inhibit the successful establishment and growth of selected coniferous tree species.

² W.H. van Heek. 1966. Assessment of regeneration in Tree-Farm licence Number 1. Vancouver, B.C. Unpublished thesis for registration in the Association of B.C. Professional Foresters.

TABLE 5. Major brush species of the CWHf

Trees:	red alder	<u>Alnus rubra</u>
	cottonwood	<u>Populus balsamifera</u> ssp.
		<u>trichocarpa</u>
	willow	<u>Salix</u> spp.
Shrubs:	red-osier dogwood	<u>Cornus sericea</u>
	black twinberry	<u>Lonicera involucrata</u>
	high-bush cranberry	<u>Viburnum edule</u>
	red elderberry	<u>Sambucus racemosa</u>
	salmonberry	<u>Rubus spectabilis</u>
	thimbleberry	<u>Rubus parviflorus</u>
	currants and gooseberries	<u>Ribes</u> spp.
	(huckleberries and blueberries)	<u>(Vaccinium</u> spp.)
Herbs:	spiny wood fern	<u>Dryopteris assimilis</u>
	lady fern	<u>Athyrium filix-femina</u>
	(bracken)	<u>(Pteridium aquilinum)</u>

TABLE 6. Criteria for determining brush potential

Criteria	Brush potential		
	Low	Moderate	High
Moisture regime	xeric - mesic	mesic - subhygric	subhygric - hygric
Nutrient regime	low - medium	medium - rich	rich - very rich
Dominant under-story ¹ in forested ecosystem	moss and herbs few shrubs	mostly herbs moderate number of shrubs	abundant competitive shrubs and deciduous trees
Logging disturbance	low	medium	high
Relative rate and dominant mode of decomposition	slow/fungal	moderate/fungal-zoogenous	moderate to fast/ zoogenous (fungal)
Drainage	moderately good to good	good to imperfect	moderately good to poor
Seepage	rarely present	may be periodically present	periodically to permanently present
Water table	not present within 100 cm of ground surface	rarely present within 100 cm of ground surface	frequently present within 50 cm of ground surface
Mottling or gleying in upper 50 cm	not present	may be present	frequently present
Meso slope position	variable slope positions	- middle - lower - toe - (level)	- lower - toe - level - depressional

¹ Quantity and vigour of these species is related to crown closure as well as to moisture and nutrient regime.

The brushier the site the less likely natural regeneration will be able to stock an area¹.

ii) aspect

In mountainous terrain typical of the CWHF, aspect can significantly affect the local climate. On south-facing slopes (in comparison to an equal ecosystem unit on a north slope) one finds:

- a) higher insolation -higher fire hazard and risk
-lower survival due to greater moisture stress;
- b) valley updrafts -seed blown uphill.

8.2.3 Planting: species/stock type selection

The selection of species and stock type is influenced by many variables including silvics, ecology, budgets such as transportation and nursery, accessibility, site conditions, experience of planters, and timing of planting. Given the ideal combination of these variables, the "best" stock generally is the biggest and most balanced (see Table 7). However, the best stock is usually very limited in supply. Until this situation improves the optimum approach seems to be: "order (sowing request) what is best for the site but plant (stock allocation) what you can get away with" (Grunerud, personal communication, 1981). This approach fulfills two important objectives: 1) the nurseries will be aware of field needs; and 2) the riskiest sites (with respect to plantation failure) will receive the best available stock. Accordingly, Table 8

¹ W.H. van Heek. 1966. Assessment of regeneration in Tree-Farm licence Number 1. Vancouver, B.C. Unpublished thesis for registration in the Association of B.C. Professional Foresters.

TABLE 7. Relative quality of some commonly planted stock (1982)

Species ¹		Sxs		P1 ²	Ba	Hw	Hm	Cw
Best Stock	Cont. ³		BR ⁴	Cont. BR	Cont.	Cont.	Cont.	Cont.
	Styro 20 ⁵							
		Plug+1						
	415			211				
				1.5+.5				Plug+1
	313			2+1				
			1+2					
	211		2+1			211	211	SL ⁶
				2+0	211			
			2+0					
"Least Best"								

¹ Tree species symbols as in Appendix 2.

² In the CWHf be sure to use the coastal (rather than interior) variety of lodgepole pine.

³ Container (no planting check).

⁴ Bare root (possible planting check).

⁵ Research purposes only.

⁶ SL - Spencer's Lemaire.

TABLE 8. Guidelines for stock type selection in the CWHF

Site condition	Site problem	Species/stock type
Disturbance - fire, MSP, erosion, logging	site pushed back to an earlier successional stage	-choose an earlier seral species P1 - 1 1/2+1/2 BR Plug 211 (2+0 BR only if it is an easy site) (Sxs - Plug+1 if there is a chance of brush)
Brush	shading - light - temperature mechanical damage - whipping	-tall, sturdy, transplant stock that releases quickly Sxs - Plug 313 - Plug+1 (when ordering specify brush) (on easy sites -large transplants: 2+1 BR or 2+2 BR)
Dry sites - coarse texture - skeletal soils	drought - moisture stress (high evapotranspiration, low soil water retention)	-large root/shoot mass ratio and small tops P1 - 1 1/2 + 1/2 BR Plug 211 (Sxs - Plug 313 on a dry site for spruce)
Fine textured soils (silts)	frost heaving	-high root/shoot mass P1 - 1 1/2 + 1/2 BR Sxs - if plug then spring plant only - with mattock
Otherwise	no problems	-flexible; e.g., 2+0 BR Plug 211

lists the major ecological factors to be considered and suggests appropriate stock types to match. For a general reference see Section 4 and 6, Silviculture Manual, British Columbia Ministry of Forests.

8.2.4 Insects and disease

Insect and disease problems occur in all types of ecosystems of the CWHf. Potential problems must be recognized or anticipated and taken into account in all silvicultural prescriptions. The identification and treatment of the various forest insects and diseases are adequately covered in the literature (e.g., Baranyay and Smith 1972; Laurent 1974; Thomas et al. 1975; McMullen 1976; Wallis 1976; Scharpf and Parmeter 1978; Rudinsky 1979; Cole and Amman 1980; Stock 1981¹; Canadian Forestry Service, Forest Pest Leaflets) and will not be dealt with in detail here. Table 9 presents a summary of the major insects and diseases of commercial tree species in the CWHf.

8.3 Silvicultural Prescriptions

In the preceding sections we have discussed the major silvicultural topics that must be considered in the formulation of a silvicultural prescription for an ecosystem association. In Sections 8.3.1 and 8.3.2, respectively, we present silvicultural prescriptions for each forested ecosystem association of the Coastal Western Hemlock "f" subzone. These prescriptions should serve as guides in the selection of appropriate silvicultural treatments on an ecosystem basis. The ability to identify the ecosystem associations is a prerequisite for use of the prescriptions.

¹ A.J. Stock. 1981. Guidelines for control of dwarf mistletoe in the Prince Rupert Forest Region. B.C. Min. For., Smithers, B.C. Unpublished manuscript.

Table 9. Major insects and diseases of the CWHf¹

Insects	Target species ²	Severity in subzone	Comments
Mature trees			
blackheaded budworm (<u>Acleris gloverana</u>)	H,B (S)	Light	Endemic at present. Previous epidemics (1952-53, 61-62 and 72-74). Expected to continue at endemic levels in 1981.
spruce beetle (<u>Dendroctonus rufipennis</u>)	S	Light	Not common in this subzone.
mountain pine beetle (<u>Dendroctonus ponderosae</u>)	P	Light	Rarely occurs; only recorded in this subzone along the Skeena R. between Little Oliver Ck. and Skeena Crossing above ICHg.
spruce budworm (<u>Choristoneura occidentalis</u>)	B,(S,Hw)	Light (moderate to severe potential)	Caused light defoliation in Kitimat Valley in 1980 -first defoliation since 1969. Previous outbreak 1960-63. Increased defoliation in 1980.
saddle-back looper (<u>Ectropis crepuscularia</u>)	Hw (Cw,B,S)	Light	Has caused defoliation in extreme southern portion of subzone (1969). Elsewhere, light populations. Not expected to be problem in subzone.
spruce budmoth (<u>Zelraphera canadensis</u>)	Ss	Light	Low population at present. Can cause tree deformity by tip killing. Larvae common from Exstew to Cedarvale.

TABLE 9. (cont'd)

Insects	Target species	Severity in subzone	Comments
Seedlings			
spruce weevil (<u>Pissodes strobi</u>)	S	Light	Moderate to severe potential. Becoming a noticeable problem in Kitimat and Kalum Valley plantations.
woolly aphid (<u>Pineus</u> sp.)	S	Light-moderate	Common in spruce plantations in subzone. Severe cases in Kitimat and Kalum Valley plantations (particularly in dry ecosystems).
Disease			
dwarf mistletoe (<u>Arceuthobium tsugense</u>)	Hw	Light to moderate (mature stands); Light (young stands)	A few young stands infested south of Terrace, but very light north of Terrace. Mature stands generally light - moderately infected where mistletoe occurs.
butt, stem and root rots e.g., <u>Armellaria</u> , <u>Phellinus</u> , <u>Fomes</u>	All species	Light in young stands; Mod. - severe in mature and over-mature stands	Long-term problem. Will gradually improve with logging of overmature timber (except <u>Fomes</u> and <u>Phellinus</u>).
Others	Hw, Ba Pl, Cw	Light, 1975 Severe, 1978 Moderate, 1980	Winter drying is a common phenomenon in Kitimat, Kalum and Nass Valleys, as is late frost that frequently desiccates new growth.
	All species	Light ?	Fluoride poisoning around Kitimat

¹ Peter Koot)
Don Doidge) personal communications, 1981.
Kevin Weiden)

² Tree species symbols as in Appendix 2.

The silvicultural prescriptions are summarized in Table 10. Ecosystems that are essentially similar with respect to silvicultural treatments have been combined; the CWHf1/02 has been split because of silvicultural implications. The prescriptions have been laid out in a manner that provides the user with an increasing level of detail as follows:

- i) PRESCRIPTION - succinctly outlines the recommended options.
- ii) CAUTIONS - provides further information and qualifications on the PRESCRIPTION.
- iii) COMMENTS - elaborates on and broadens the PRESCRIPTION and CAUTIONS.
- iv) At this point, if users wish more guidance they can return to the introductory Section 8.1 for clarification and literature references.

The terms used under ACTIVITY in the silvicultural prescriptions are all self-explanatory except possibly MSP, which is an abbreviation for mechanical site preparation.

8.3.1 Prescriptions for the CWHf1

TABLE 10. Summary of silvicultural prescriptions for the CWHf1

Ecosystem unit	Site preparation		Species ²	Brush	Stand
	Fire ¹	Other	Selection ³	Potential	Tending
CWHf1/01 CWHf1/01/a	OK		P: Sxs, Hw A: Pl, (Ba) U: (Ba)	Light	B&W ⁴ not req'd Spac. ⁴ usually required
CWHf1/02	Avoid		P: Pl A: (Hw), (Sxs) U: Ba, Cw, (Sxs, Hw)	None	B&W as req'd Spac.
CWHf1/02 (fluvial terraces) CWHf1/02/a	Avoid	OK for MSP	P: Pl A: (Hw, Sxs, Cw) U: Ba, (Hw, Sxs, Cw)	None	B&W as req'd Spac.
CWHf1/03	OK		P: Sxs A: Hw, Ba, Cw, Pl (short rot'n.) U: Pl (long rot'n.)	Mod. - Severe	B&W - as req'd Spac. - as req'd (usually requires spacing if not burned)
CWHf1/04 ⁵	Often OK	(Herbi- cides?)	A: Sxs, Ba, Hw Cw, Pl (short rot'n.) U: Pl (long rot'n)	(Mod. - Severe	B&W - req'd Spac. - as req'd
CWHf1/05 ⁶ CWHf1/05/a	Often OK	OK (aggra- vates brush - herbicides)	P: Sxs A: Cw, Hw, (Ba) (poplars)	Severe	B&W - req'd Spac. - as req'd
CWHf1/06	Avoid	Avoid	P: Sxs A: Cw, (Ba) U: Hw, (Ba)	Variable	B&W as req'd Spac.

¹ If burned, then plant. DO NOT Burn on fragmental or skeletal soils.

² Tree species symbols as in Appendix 2.

³ P = preferred; A = acceptable; U = unacceptable.

⁴ B&W = Brushing and Weeding; Spac. = Spacing or pre-commercial thinning.

⁵ Plan ahead - timing of activities is critical.

⁶ DO NOT LOG until a total management plan has been approved - execution is critical.

ECOSYSTEM UNIT(S): CWHf1/01 Zonal hemlock — Vaccinium — moss
CWHf1/01(1) Moss variation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	— Sxs, Hw preferred	— long-term role of Sxs is unknown
Site Prep.		
— fire	— OK; avoid if possible	— protect acceptable advanced regeneration
Reforestation	— use acceptable adv. Hw and Ba	— mistletoe is common
	— if req'd, plant (fill plant) with spruce (or Hw)	— spruce weevil prefers long leaders
Brush and Weed	— assess need — at time of regen. survey	
Spacing	— usually required	
	— assess 5 to 10 years after establishment	
COMMENTS		
Species Selection	— acceptable: Pl, (Ba — only on moister and richer examples of these units)	
	— unacceptable: (Ba)	
Site Prep.		
— fire	— usually unnecessary due to adequate advanced regeneration	
	— planting required if burned: delay planting 2–3 years; otherwise expect poor survival	
— brush	— light (occasionally moderate)	
	— at higher elevations <i>Vaccinium</i> , if not burned, may pose a problem to planters and initial growth of trees	
Brush and Weed	— generally not required	
Spacing	— during spacing assessment be particularly critical of Ba. This species will likely slow down on drier, poorer examples of these units.	

ECOSYSTEM UNIT(S): CWHf1/02 Dry hemlock — moss (except on fluvial terraces)

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection — PI preferred		— don't use interior provenances
Logging		— small amounts of disturbance and subsequent erosion may have a large impact on future production
Site Prep. — avoid, particularly on steep slopes		
Reforestation — plant with PI		
Brush and Weed — as required		
Spacing — as required — generally unwarranted		
COMMENTS		
Species Selection — acceptable: (Hw — on deep organic matter), (Sxs — moister examples of this unit) — unacceptable: Ba, Cw, (Sxs, Hw) — a minor component of aspen may improve the site by promoting decomposition and incorporation of litter into soil.		
Site Prep. — fire — organic horizons are very beneficial for these units unless they are too thick (greater than 15 cm); therefore <i>avoid</i> burning — provided <i>only</i> the L horizon is consumed, burning is OK — if advanced regeneration is unacceptable, consider a light burn (spring) — brush — no problem — MSP — soils generally too shallow or too steep for scarification		
Brush and Weed and Spacing — higher priorities elsewhere will normally preclude stand tending on these units. However, if required, eliminate true firs and reduce hemlock component as much as possible. Wider espacement than on moister units may be desirable (to enhance moisture availability).		

ECOSYSTEM UNIT(S): CWHf1/02 Dry hemlock — moss (fluvial terraces)
CWHf1/02(1) Outwash pine variation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	— PI preferred	— don't use interior provenances
Logging	— promote PI regen.	— PI cones are much less serotinous than those in the Interior
Site Prep.		
— fire	— avoid	— protect silt capping if present (moisture retention)
— MSP	— OK	
Reforestation	— plant (fill plant with PI, if required)	
Brush and Weed	— as required	
Spacing	— as required — usually unwarranted	
COMMENTS		
Logging	— if PI is a significant part of the canopy, adjust season and method of logging to promote PI regen. (e.g., summer log with skidders).	
Species Selection	— acceptable: (Hw — on deep organic matter), (Sxs — moister examples of this unit), (Cw — may have some pole potential) — unacceptable: Ba, (Hw, Cw, Sxs) — a minor component of aspen may improve the site by promoting decomposition and incorporation of litter into soil.	
Site Prep.		
— fire	— organic horizons are very beneficial for these units unless they are too thick (greater than 15 cm); therefore <i>avoid</i> burning — provided <i>only</i> the L horizon is consumed, burning is OK — if advanced regen. is unacceptable, consider a light burn (spring)	
— brush	— no problem	
— MSP	— level, well-drained, coarse-textured soils typical of these units are adaptable to a wide range of machines. DO NOT SCALP.	
Brush and Weed and Spacing	— higher priorities elsewhere will normally preclude stand tending on these units. However, if required, eliminate true firs and reduce hemlock component as much as possible. Wider espacement than on moister units may be desirable (to enhance moisture availability).	

ECOSYSTEM UNIT(S): CWHf1/03 Devil's club — oak fern

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	— Sxs preferred	
Logging	— minimize slash production — minimize disturbance	— this unit often exists in complex with 01 as hollows which typically collect slash — logging during wetter seasons aggravates site disturbance problems (e.g., brush)
Site Prep. — fire	— OK	— burns must be planted
Reforestation	— utilize acceptable Hw and Ba — if planting is required, do so immediately with Sxs	— mistletoe is common — spruce weevil prefers the long leaders produced on this unit
Brush and Weed	— assess need — at time of first survival assessment	
Spacing	— plant for spacing assessment	
COMMENTS		
Species Selection	— acceptable: Hw, Ba, Cw, Pl on short rotations (less than 80 years) — unacceptable: Pl on long rotations	
Site Prep. — fire	— often unnecessary due to complexing with CWHf1/01 — that is, overall stocking is usually adequate — avoid burning — on shallower soils (shallow to bedrock, pans, or water table) — if you can plant around slash pockets to get acceptable stocking	
— brush	— moderate to severe — depends on mature stand structure and amount of disturbance	
Brush and Weed	— as required	
Spacing	— if not burned this unit will likely require spacing.	

ECOSYSTEM UNIT(S): CWHf1/04 Devil's club — lady fern — oak fern

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	— variable (see below)	
Treatment Plan	— plan ahead (leadtime!)	— timing is CRITICAL. These units must be planned in detail and closely controlled to avoid brush problems and site degradation
Logging	— log during drier seasons (winter log — spring burn) — minimize slash accumulation — minimize disturbance (duration and degree)	
Site Prep. — fire	— do not burn on fragmental or skeletal soils, otherwise OK	
Reforestation	— plant immediately with healthy, sturdy stock (see below)	
Brush and Weed	— plan for brush and weed assessment at time of planting	
Spacing	— as required	
COMMENTS		
Logging	— try to layout these units within a separate opening to facilitate speed and control — log cleanly, carefully, and quickly! — avoid these ecosystems for road building and skid trails — consider selective logging	
Species Selection	— acceptable: Sxs — spruce weevil prefers the long leaders these sites produce Ba — preferable in cold valley drainages Hw — preferred on deeper humus mounds Cw — this is its best site but is slower growing than the above species PI — acceptable on short rotations only — unacceptable: PI — on long rotations (longer than 80 years)	
Site Prep. — fire	— often difficult to get a good burn due to wetness of site and rapid brushing-in — try burning in the very dry times of year	
— brush	— usually severe — plan everything to minimize this problem	
— MSP	— generally not recommended because of fine soil textures, wetness of site, and brush hazard	
Brush and Weed	— release (herbicides) will likely be required. Timing and method is a function of brush species, percentage cover, vigour, and elevation	
Spacing	— assess need after "free-to-grow" (release)	

ECOSYSTEM UNIT(S): CWHf1/05 Fluvial spruce — devil's club — fern ecosystem association
CWHf1/05(1) Floodplain cottonwood variation

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	— Sxs preferred	
Treatment Plan	— regen. plans must made and approved before harvesting activities (including road building) commence	— because of erosion, some examples of this unit are a poor risk for the next rotation
Logging	— log quickly and cleanly	— moving slash during flooding may damage plantation
Site Prep.		
— fire	— OK	
— MSP	— OK in conjunction with planting of jumbo stock	
Reforestation	— plant immediately with the healthiest, sturdiest, tallest spruce (Sxs) stock available — assess annually during high risk years (brush, flooding)	— avoid planting check — weevil prefers long leaders — secure supply of stock before attempting harvesting
Brush and Weed	— required	— controversy over herbicides
COMMENTS		
Logging	— consider cutting deciduous seed trees (brush potential) around opening — (consider under-planting around stumps 2 years before logging)	
Species Selection	— consider managing for short rotation poplars — depends on site; pre-logging assessment required usually preferred: Sxs acceptable: Cw, Hw, (Ba in cold drainages) — (consider mechanical planting of very large stock (2 m) at reduced stocking (200/ha)	
Site Prep.		
— fire	— unlikely to burn using conventional means (fast green-up and not much conifer slash) — generally not harmful	
— brush	— severe — burning may control for 1 or 2 years — chemicals are more effective (brown and burn?)	
— MSP	— generally OK except that it aggravates or initiates brush problems — only use MSP in conjunction with a committed brush control plan (probably should include herbicides)	
Spacing	— assess after <i>successful</i> brushing and weeding program	

ECOSYSTEM UNIT(S): CWHf1/06 Skunk cabbage

ACTIVITY	PRESCRIPTION	CAUTIONS
Species Selection	— Sxs preferred	
Logging	— do not disturb soil	— choose season of logging carefully
Site Prep. — fire	— avoid — promote natural and advanced regen.	— often the plantable area is marginally (if not fully) stocked with acceptable species — burning heavy cedar slash will reduce plantable spots
Reforestation	— if required plant Sxs	— if not logged with some care, this unit will be very difficult to plant and survival will likely be low
Brush and Weed	— determine need at time of survival assessment	
Spacing	— may be required	— often advanced regeneration, especially Hw, doesn't release
Logging	— be careful not to raise the water table through drainage interference by construction of roads and ditches, excessive use of skid trails, etc. — avoid levelling mounds or hummocks — try selective logging on examples of this unit that have poor shallow soils, stagnant water, and/or permanently high water tables	
Species Selection	— acceptable: Cw, (Ba — richer examples of this unit), (Hw — only on hummocks) — unacceptable: (Hw) (Ba)	
Site Prep. — fire	— usually undesirable due to acceptable advanced regeneration and natural seeding — burning heavy cedar slash will drastically reduce organic horizons and reduce the productive area accordingly	
— brush	— variable (assess during pre-logging assessment)	
— MSP	— generally very difficult. If used to create plantable mounds or remove slash, try to improve drainage as well (consider Marttiini plough) — best opportunity may be when ground is frozen; however, do not flatten mounds	

8.3.2 Prescriptions for the CWHf2

Experience with the CWHf2 is limited. However, there are a few important silvicultural differences between this variant and the CWHf1. Table 11 correlates the common ecosystem units of the CWHf2 with those of the CWHf1. The following prescription page, used in conjunction with the equivalent prescription from the CWHf1 (see below), will provide the appropriate prescription for the CWHf2.

TABLE 11. "Equivalent" ecosystem units of the CWHf1 and CWHf2

Ecosystem units of the CWHf2		Equivalent ecosystem unit of the CWHf1	
/01	Zonal Hw - (Ba) - <u>Vacc</u> - moss	/01	Zonal Hw - <u>Vacc</u> - moss
/01/a	Ba - moss phase	/01/a	Moss phase
/02	Dry Hw - moss	/02	Dry Hw - moss
/03	Devil's club - oak fern	/03	Devil's club - oak fern
/04	Devil's club - lady fern - oak fern	/04	Devil's club - lady fern - oak fern

ECOSYSTEM UNIT(S) OF THE CWHf2

ACTIVITY	PRESCRIPTION ¹	CAUTIONS
Species Selection	- Ba assumes more importance, (not true where soil freezes) - Cw much less important - Bl ok towards ICHg - Sxs - Sxw - rest stay the same as in comparable CWHf1 ecosystem units	
Logging	- small openings	- climate is much more severe and limiting - better density/distribution of advance regeneration than in CWHf1 - organic soil horizons are much more important
Site Prep.	- much less use of fire and MSP	
Reforestation	- go for naturals more often	- spruce weevil <u>uncommon</u>
Brush and Weed	- as for CWHf1	
Spacing	- as for CWHf1	

¹ Modifications to CWHf1 prescriptions.

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APPENDIX 1

List of Plant Names Used in the Guide

Trees:

<u>Abies amabilis</u>	amabilis fir
<u>Abies lasiocarpa</u>	subalpine fir
<u>Alnus rubra</u>	red alder
<u>Betula papyrifera</u>	paper birch
<u>Chamaecyparis nootkatensis</u>	yellow-cedar
<u>Juniperus scopulorum</u>	Rocky Mountain juniper
<u>Picea engelmannii</u>	Engelmann spruce
<u>Picea glauca</u>	white spruce
<u>Picea mariana</u>	black spruce
<u>Picea sitchensis</u>	Sitka spruce
<u>Picea sitchensis</u> x <u>glauca</u>	Roche spruce
<u>Pinus contorta</u>	lodgepole pine
<u>Populus balsamifera</u> ssp. <u>trichocarpa</u>	black cottonwood
<u>Populus tremuloides</u>	trembling aspen
<u>Pseudotsuga menziesii</u>	Douglas-fir
<u>Taxus brevifolia</u>	western yew
<u>Thuja plicata</u>	western redcedar
<u>Tsuga heterophylla</u>	western hemlock
<u>Tsuga mertensiana</u>	mountain hemlock

Shrubs:

<u>Acer glabrum</u>	Douglas maple
<u>Alnus viridis</u> ssp. <u>sinuata</u>	Sitka alder
<u>Amelanchier alnifolia</u>	Saskatoon
<u>Cornus sericea</u>	red-osier dogwood
<u>Corylus cornuta</u>	hazelnut
<u>Gaultheria shallon</u>	salal
<u>Kalmia microphylla</u>	bog-laurel
<u>Ledum groenlandicum</u>	Labrador tea
<u>Lonicera involucrata</u>	black twinberry
<u>Malus fusca</u>	Pacific crab apple
<u>Menziesia ferruginea</u>	false azalea
<u>Oplopanax horridus</u>	devil's club
<u>Paxistima myrsinites</u>	falsebox
<u>Ribes bracteosum</u>	stink currant
<u>Ribes lacustre</u>	black gooseberry
<u>Ribes</u> spp.	currants and gooseberries
<u>Rosa acicularis</u>	prickly rose
<u>Rosa nutkana</u>	Nootka rose
<u>Rubus parviflorus</u>	thimbleberry
<u>Rubus spectabilis</u>	salmonberry

APPENDIX 1 (continued)

Sambucus racemosa
Shepherdia canadensis
Spiraea douglasii
Symphoricarpos albus
Vaccinium alaskaense
Vaccinium membranaceum
Vaccinium ovalifolium
Vaccinium parvifolium
Vaccinium uliginosum
Viburnum edule

red elderberry
soopolallie
hardhack
common snowberry
Alaskan blueberry
black huckleberry
oval-leaved huckleberry
red huckleberry
bog blueberry
highbush-cranberry

Herbs:

(includes dwarf shrubs)

Adiantum pedatum
Andromeda polifolia
Aralia nudicaulis
Arctostaphylos uva-ursi
Aruncus dioicus
Asarum caudatum
Athyrium filix-femina
Blechnum spicant
Carex spp.
Cassiope mertensiana
Chimaphila umbellata
Circaea alpina
Clintonia uniflora
Coptis trifolia
Corallorhiza maculata
Cornus canadensis
Disporum hookeri
Drosera anglica
Drosera rotundifolia
Dryopteris assimilis
Epilobium angustifolium
Equisetum arvense
Equisetum hyemale
Equisetum pratense
Equisetum spp.
Galium triflorum
Goodyera oblongifolia
Gymnocarpium dryopteris
Hemitomes congestum
Lathyrus nevadensis

maidenhair fern
bog rosemary
wild sarsaparilla
kinnikinnick
goat's-beard
wild ginger
lady fern
deer fern
sedges
white mountain-heather
prince's pine
enchanter's nightshade
queen's cup
three-leaved goldthread
spotted coralroot
bunchberry
Hooker's fairybells
long-leaved sundew
round-leaved sundew
spiny wood fern
fireweed
common horsetail
scouring-rush
meadow horsetail
horsetails
sweet-scented bedstraw
rattlesnake-plantain
oak fern
gnome-plant
purple peavine

APPENDIX 1 (continued)

<u>Linnaea borealis</u>	twinflower
<u>Listera cordata</u>	heart-leaved twayblade
<u>Luetkea pectinata</u>	partridgefoot
<u>Lysichiton americanum</u>	skunk cabbage
<u>Maianthemum dilatatum</u>	false lily-of-the-valley
<u>Melampyrum lineare</u>	narrow-leaved cow-wheat
<u>Menyanthes trifoliata</u>	buckbean
<u>Mitella nuda</u>	common mitrewort
<u>Moneses uniflora</u>	single delight
<u>Orthilia secunda</u>	one-sided wintergreen
<u>Oryzopsis asperifolia</u>	rough-leaved ricegrass
<u>Oryzopsis pungens</u>	short-awned ricegrass
<u>Osmorhiza chilensis</u>	mountain sweet-cicely
<u>Phyllodoce empetriformis</u>	pink mountain-heather
<u>Platanthera dilatata</u>	white bog-orchid
<u>Platanthera orbiculata</u>	round-leaved rein-orchid
<u>Polystichum munitum</u>	western sword fern
<u>Potentilla palustris</u>	marsh cinquefoil
<u>Rubus pedatus</u>	five-leaved bramble
<u>Rubus pubescens</u>	trailing raspberry
<u>Sanguisorba canadensis</u>	Sitka burnet
<u>Scheuchzeria palustris</u>	scheuchzeria
<u>Streptopus amplexifolius</u>	clasping twistedstalk
<u>Streptopus roseus</u>	rosy twistedstalk
<u>Streptopus streptopoides</u>	small twistedstalk
<u>Tiarella trifoliata</u>	three-leaved foamflower
<u>Tiarella unifoliata</u>	one-leaved foamflower
<u>Trientalis europaea ssp. arctica</u>	northern starflower
<u>Vaccinium caespitosum</u>	dwarf blueberry
<u>Vaccinium oxycoccos</u>	bog cranberry
<u>Valeriana sitchensis</u>	Sitka valerian
<u>Veratrum viride</u>	Indian hellebore
<u>Viola canadensis</u>	Canada violet
<u>Viola glabella</u>	stream violet
<u>Viola spp.</u>	violets

Moss layer:
(includes lichens and liverworts)

<u>Aulacomnium palustre</u>	ribbed bog moss
<u>Barbilophozia spp.</u>	leafy liverworts
<u>Brachythecium spp.</u>	mosses
<u>Cladina spp.</u>	reindeer lichens
<u>Cladonia spp.</u>	lichens

APPENDIX 1 (continued)

<u>Dicranum polysetum</u>	wavy-leaved moss
<u>Dicranum spp.</u>	mosses
<u>Hylocomium splendens</u>	step moss
<u>Isoetecium spiculiferum</u>	variable moss
<u>Mnium spp.</u>	leafy mosses
<u>Peltigera spp.</u>	lichens
<u>Plagiochila porelloides</u>	liverwort
<u>Plagiothecium undulatum</u>	flat moss
<u>Pleurozium schreberi</u>	red-stemmed feather moss
<u>Polytrichum juniperinum</u>	juniper haircap moss
<u>Ptilium crista-castrensis</u>	knight's plume
<u>Rhytidiadelphus loreus</u>	little shaggy moss
<u>Rhytidiadelphus triquetrus</u>	electrified cat's-tail moss
<u>Rhytidiopsis robusta</u>	pipecleaner moss
<u>Scapania bolanderi</u>	liverwort
<u>Sphagnum spp.</u>	sphagnum
<u>Stereocaulon spp.</u>	lichens
<u>Stokesiella oregana</u>	Oregon beaked moss

APPENDIX 2

List of Tree Species Symbols Used in the Guide

Genus	Species/Hybrid	Genus symbol	Species or hybrid symbol	Subspecies or variety symbol
Alder <u>Alnus</u>	Red alder (<u>A. rubra</u>)	D	Dr	
Balsam or Fir <u>Abies</u>	Amabilis fir (<u>A. amabilis</u>) Subalpine fir (<u>A. lasiocarpa</u>)	B	Ba Bl	
Birch <u>Betula</u>	Paper birch (<u>B. papyrifera</u>)	E	Ep	
Cedar <u>Thuja</u>	Western redcedar (<u>T. plicata</u>)	C	Cw	
Hemlock <u>Tsuga</u>	Mountain hemlock (<u>T. mertensiana</u>) Western hemlock (<u>T. heterophylla</u>)	H	Hm Hw	
Pine <u>Pinus</u>	Lodgepole pine (<u>P. contorta</u> var. <u>latifolia</u>)	P	Pl	Pli (interior)
Poplar <u>Populus</u>	Trembling aspen (<u>P. tremuloides</u>) Black cottonwood (<u>P. balsamifera</u> ssp. <u>trichocarpa</u>)	A	At Ac	Act
Spruce <u>Picea</u>	Black spruce (<u>P. mariana</u>) Engelmann spruce (<u>P. engelmannii</u>) Sitka spruce (<u>P. sitchensis</u>) White spruce (<u>P. glauca</u>) Hybrid spruce (unknown origin) White x Engelmann (Interior) White x Sitka (Roche) White x Engelmann x Sitka	S	Sb Se Ss Sw Sx Sxw Sxs Sxx	

APPENDIX 3

Glossary

Ah - a surface or near-surface mineral horizon of organic matter accumulation. It contains less than 17% organic carbon. It is one Munsell unit of colour value darker than the layer immediately below, or it has at least 0.5% more organic carbon than the 1C horizon, or both.

alluvial - recent fluvial (see below).

association, plant - an abstract concept comprising all climax stands of vegetation (or plant communities) in which the dominant species of corresponding layers are essentially the same.

available water - the portion of water in a soil that can be readily absorbed by plant roots.

basal till - an unsorted, unstratified mixture of sand, silt, clay, and coarser fragments deposited by ice without additional transportation by water.

biogeoclimatic phase - a significant, extensive area of ecosystems that is, for topographic or topoedaphic reasons, atypical for the regional climate; i.e., a phase reflects local climate.

biogeoclimatic subzone - a subdivision of a zone characterized by a distinct climatic climax or zonal ecosystem association described in terms of vegetation and soil. It consists of unique sequences of geographically related ecosystems in which climatic climax ecosystems are members of the same ecosystem association.

biogeoclimatic variant - a subdivision of a subzone based on differences in regional climate. It is characterized by a distinct zonal ecosystem association plus a supplementary combination of environmental factors (vegetation, soil, ecosystem productivity).

biogeoclimatic zone - a large geographic area that has a broadly homogeneous mesoclimate and exhibits similar patterns of soil and vegetation. It is made up of closely related subzones, and is characterized by a group of closely related, zonal ecosystem associations.

bog - a wetland covered or filled with poorly to moderately decomposed Sphagnum-derived peats. It is strongly acid and low in nutrients.

cemented layer - having a hard, brittle consistence because the particles are held together by cementing substances such as humus, calcium carbonate, or the oxides of silicon, iron, and aluminium.

clay films (skins) - coatings or oriented clays on the surfaces of soil peds and mineral grains, and in soil pores.

climax, types of:

climatic - an equilibrium condition of an ecosystem that reflects the development potential of the mesoclimate or regional climate of an area. It is characterized by a zonal or mesic ecosystem.

edaphic - differs from the climatic climax as a result of overriding soil or substrate conditions.

fire - results from recurrent wildfire.

topographic - reflects the effects of topography on local or microclimate.

coarse fragments - rock or mineral particles greater than 2.0 mm in diameter (includes gravels, cobbles, and stones).

colluvial - unconsolidated materials deposited by mass wasting (direct gravitational action) on or at the base of steep slopes. The materials usually consist of coarse, angular, fractured bedrock, but the bedrock fragments may also be mixed or associated with redistributed glacial till.

community, plant - an area of relatively uniform vegetation. An assemblage of plant populations, forming a system of organisms living together and linked by their effects on one another and their responses to the environment they share.

drift - glacial deposits.

ecosystem - a portion of the landscape and the life on and in it, or a community and its environment treated together. For our purposes: a plant community plus the soil polypedon on which it occurs.

ecosystem association - all ecosystems (land areas plus their biota) capable of producing vegetation belonging to the same plant association at climax.

ecosystem, mesic - the expression of intermediate or medium moisture and nutrient conditions for a particular geographical area. Synonymous with "zonal" or "climatic climax" ecosystem.

ecosystem phase - a subdivision of an ecosystem association (or sub-association) based on contrasting soil or landform characteristics, such as soil texture, slope classes, aspect, parent materials, bedrock geology, or soil climate.

ecosystem type - all land areas capable of producing vegetation belonging to the same plant association at climax on soil of a single soil family.

ecosystem variation - a subdivision of an ecosystem association used to describe vegetative trends or floristic features that diverge somewhat from the central concept of the association. It may be used to describe successional stages or variation in stand structure, species composition, understory features, etc.

ecosystem, zonal - the ecosystem that best reflects the regional climate. Synonymous with "mesic" and "climatic climax" ecosystem.

edaphic - of or relating to the soil.

edatope - the physical component of an ecosystem; more or less synonymous with habitat.

edatopic grid - a graphic display of the range of moisture and nutrient conditions over which an ecosystem unit or plant develops, with the ecological moisture regime on the vertical axis and the ecological nutrient regime on the horizontal axis.

ericaceous - belonging to the Ericaceae or heather family of flowering plants.

esker - a winding ridge of irregularly stratified sand, gravel, and cobbles deposited under the ice by a rapidly flowing glacial stream.

evapotranspiration - the loss of water from a given area during a specified time by evaporation from the soil surface and by transpiration from the plants.

fabric - the physical constitution of a material, in this case the humus.

fluvial - of or pertaining to rivers; produced by river action, as a fluvial plain.

fluvioglacial (= fluvialglacial, glaciofluvial) - refers to material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.

forb - a herb other than a grass, sedge, or other plant with similar foliage.

glacial outwash - stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice.

glacial till - unsorted and unstratified glacial drift, generally unconsolidated, deposited directly by a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

glaciofluvial (= fluvioglacial, fluvialglacial) see "fluvioglacial".

glaciolacustrine - refers to material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice.

gleyed, gleying - a soil-forming process, operating under poor drainage conditions, that results in the reduction of iron and other elements and in gray colours and mottles.

growing degree days - the difference between the mean daily temperature and a selected standard temperature (e.g., 5°C or 10°C), accumulated daily over a period of time such as the growing season or a calendar year.

horizons:

"A" horizon - the uppermost soil horizon; the area of maximum accumulation of organic matter in situ; the area of maximum removal of materials by solution, suspension, and erosion.

"B" horizon - the area of accumulation or enrichment of translocated substances organic matter, clay, iron, and aluminum.

"C" horizon - parent material relatively unaffected by major soil-forming processes, except for gleying (Cg) and the accumulation of carbonates and soluble salts.

humus - the complex organic products of the decomposition of plant or animal debris. These materials are more stable than their precursors, and are generally dark in colour, colloidal, and commonly associated with mineral constituents in soil.

kame - a glaciofluvial landform that generally takes the form of a conical, steep-sided hill or short ridge. It is composed of moderately sorted sands or gravels.

lacustrine - refers to material deposited in lake water and later exposed either by lowering of the water level or by uplifting of the land. These sediments range in texture from sands to clays.

marsh - a wetland that is permanently or seasonally inundated with nutrient-rich water, and that supports extensive cover of emergent herbaceous vegetation rooting in mineral-rich substrate.

mesic - intermediate or medium moisture conditions; that is, neither very wet nor very dry. The term refers to habitats that have neither an excess nor a shortage of water, relative to the existing extremes in a given area.

moder - a zoogenous forest humus form made up of plant remains partly disintegrated by the soil fauna (F layer); generally not matted as in mors; mineral grains may permeate organic horizons; insect droppings are common.

mor (raw humus) - a non-zoogenous forest humus form; commonly acidic; distinguished by a matted F layer; fungal mycelia are common.

morainal - refers to materials deposited directly from glacial ice. Sediments are generally compact, non-sorted, and non-stratified and contain a heterogeneous mixture of particle sizes. Fragments are typically slightly rounded to somewhat angular. (Synonymous with "glacial till").

morainal blankets - mantles of morainal material that are greater than 1 m in depth. They are closely associated with long, smooth, bedrock-controlled slopes.

morainal till - non-sorted and non-stratified glacial stony clay accumulated chiefly by the direct action of glacial ice.

morainal veneers - shallow (often discontinuous) mantles of morainal material less than 1 m thick. They occur upslope, on bedrock knobs, or in other locations where bedrock frequently outcrops.

mottling - formation or presence of spots or blotches of different colour or shades of colour interspersed with the dominant colour of the soil.

mull - a zoogenous forest humus form consisting of a mixture of well-humified organic matter and mineral soil that makes a gradual transition to the horizon underneath. It is distinguished by a granular structure. Because of the activity of the burrowing microfauna (mostly earthworms), partly decomposed organic debris does not accumulate as a distinct layer (F layer) as in mor and moder. Found primarily in grasslands.

mycelia - a mass of threadlike filaments, often branched and white or yellow in colour, forming the vegetative structure of a fungus.

orthic - true; of or pertaining to the central concept.

ped - a unit of soil structure such as a block or granule which is formed by natural processes.

pedon - the smallest unit or volume of soil that represents all the horizons of the soil profile. It is usually about one square metre, but can be larger.

pH - the degree of acidity or alkalinity of a soil. In forests soils, the pH ranges are:

pH 3-6.9	- Acidic
pH 7.0	- Neutral
pH 7.1-9.0	- Basic

polypedon, soil - a volume of relatively uniform soil; made up of more than one pedon.

potential evapotranspiration (PET) - the evaporation from an extended surface of short green crop that fully shades the ground, exerts little or negligible resistance to the flow of water, and is always well supplied with water. Potential evapotranspiration cannot exceed free water evaporation under the same weather conditions. PET is a function of the amount of solar radiation available, the humidity, and the surrounding air temperature.

seral stage - non-climax, successional stage in the development of an ecosystem.

soil family - a category in the Canadian system of soil classification.

Differentiae are primarily texture, drainage, thickness of horizons, permeability, mineralogy, consistence, and soil climate.

soil polypedon - a volume of relatively uniform soil.

solum - the upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

succession, ecological - the progression of ecosystems through time.

successional stage - a step in the progressive development of an ecosystem.

swamp - wooded wetland dominated by 25% or greater cover of trees or tall shrubs, and characterized by periodic flooding and nearly permanent subsurface water flow through various mixtures of mineral sediments and peat. Swamps are rich in minerals and nutrients and, with the characteristic water movement, are sufficiently aerated to support either tall shrubs or trees.

terric layer - an unconsolidated mineral substratum underlying organic soil material.

topoedaphic - of or pertaining to a combination of topography and soil.

wetlands - wetlands are lands that are wet enough or inundated frequently enough to develop and support a distinctive natural vegetative cover that is in strong contrast to the adjacent matrix of better-drained lands.

zonal - representative of the mesoclimate or prevailing regional climate of an area. Synonymous with "climatic climax" and "mesic".

Other Recent Titles in the Land Management Report Series

D.V. Meidinger, G.D. Hope, and A.J. McLeod. 1984. Classification and Interpretation of Some Ecosystems of the Rocky Mountain Trench, Prince George Forest Region, British Columbia. First Approximation. Land Mgmt. Report No. 22. 308 p. plus 2 maps.

This manual includes a brief description of the ecosystem classification system; a general introduction to the vegetation, soils, and climate of the study area; a characterization of the biogeoclimatic zones and subzones of the area; detailed descriptions of the ecosystem units; and selected management interpretations for these units. The study area is primarily located in the Rocky Mountain Trench and in some low elevation side-valleys of the Rocky and Columbia Mountains, between Purden Lake in the northwest and Mica Creek in the southeast.

R.W. Campbell, E.D. Forsman, and B.M. Van Der Raay. 1984. An Annotated Bibliography of Literature on the Spotted Owl. Land Mgmt. Report No. 24. 116 p.

The Spotted Owl (Strix occidentalis) was first described by John Xantus, who collected a specimen near Fort Tejon, California in 1859. During the next 15 years the species remained relatively unknown, primarily because of its nocturnal habits and its preference for dense forests in remote, mountainous areas. In the early 1970's, pioneering studies on the Spotted Owl were initiated in Oregon and California. During the decade which followed, this species became the most intensively studied owl on the continent.

Results from research have created a concern for the future of the Spotted Owl in North America. These concerns include:

1. The owl's presumed incompatibility with intensive forest management practices which directly, and indirectly may affect its living space, prey base, and reproductive capacity.
2. The possible threat posed by the invasion of the Barred Owl (Strix varia) into the range of the Spotted Owl.

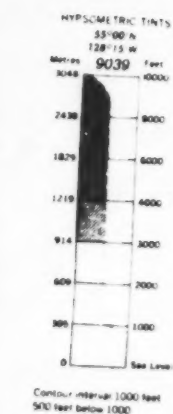
There is, then, considerable demand for information on the Spotted Owl. This bibliography includes 586 citations and is current through 1983.

CANADA
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH

(Joins Selkine River 104 S.E.)

ELEVATIONS IN FEET

Transverse Mercator Projection



CONVERSION TABLE
LOGARITHMIC SCALE

CANADA
DEPARTMENT OF
ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH

(Joina Selkine River 104 S.E.)

ELEVATIONS IN FEET

Transverse Mercator Projection

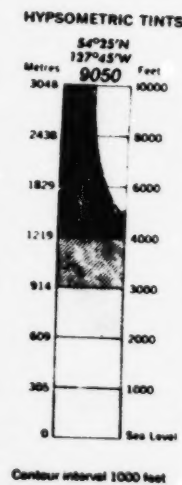
ELEVATIONS IN FEET



Johns Smithers-Fort St. James 72

CANADA
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ENERGY, MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
(Johns Pinley River 94 S.W.)

Transverse Mercator Projection



(Join Prince Rupert-Stewart 103 N.E.)

**CONVERSION TABLE
LOGARITHMIC SCALE**

METRES	FEET
8000	26000
5000	15000

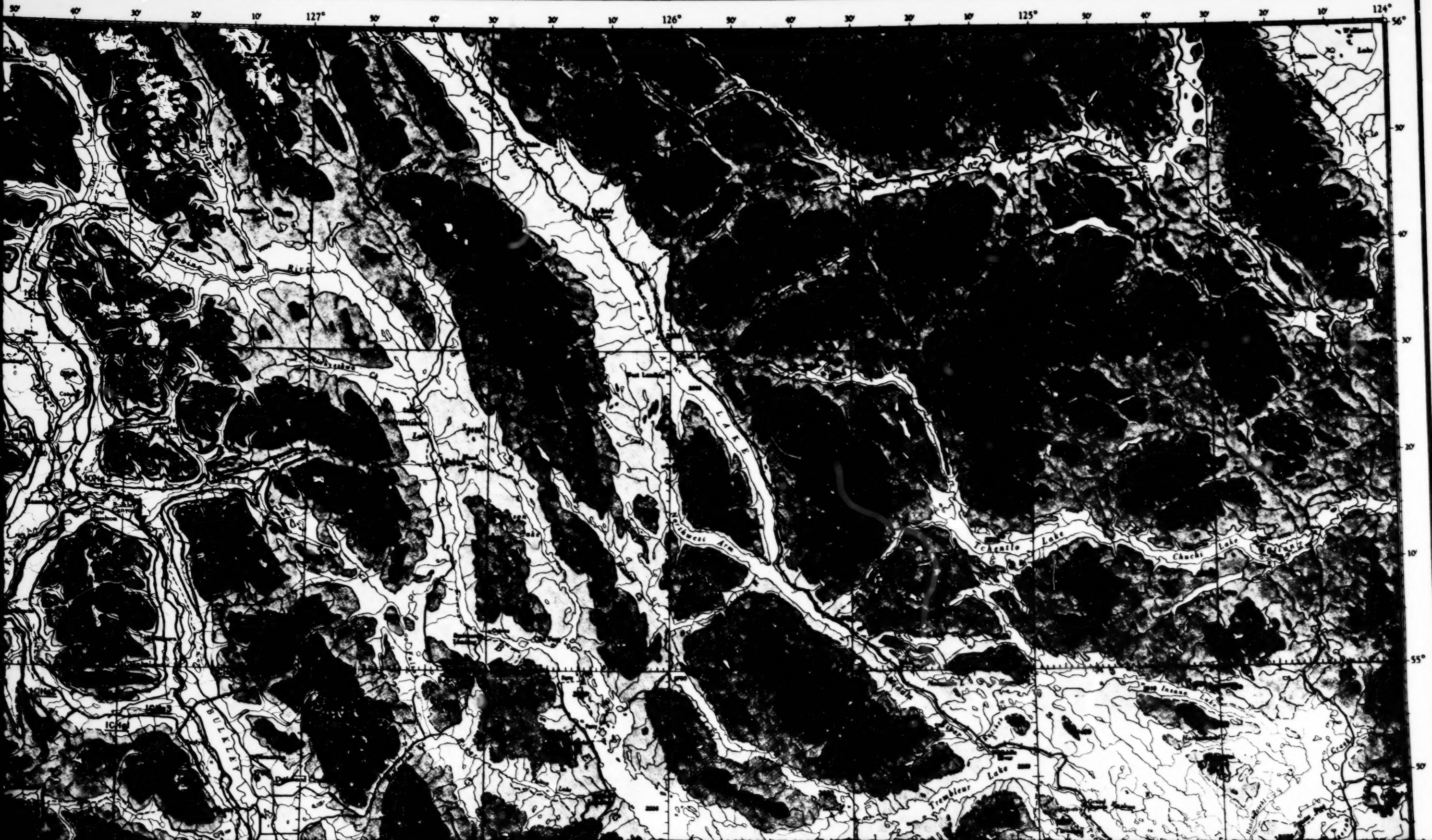
PORT ST. JAMES
ELEVATIONS IN FEET

CANADA
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SURVEYS AND MAPPING BRANCH
(Join Pinkey River 94 S.W.)

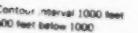
ELEVATIONS IN FEET

Transverse Mercator Projection

ELEVATIONS IN FEET



(Join Pinkey River 94 S.W.)



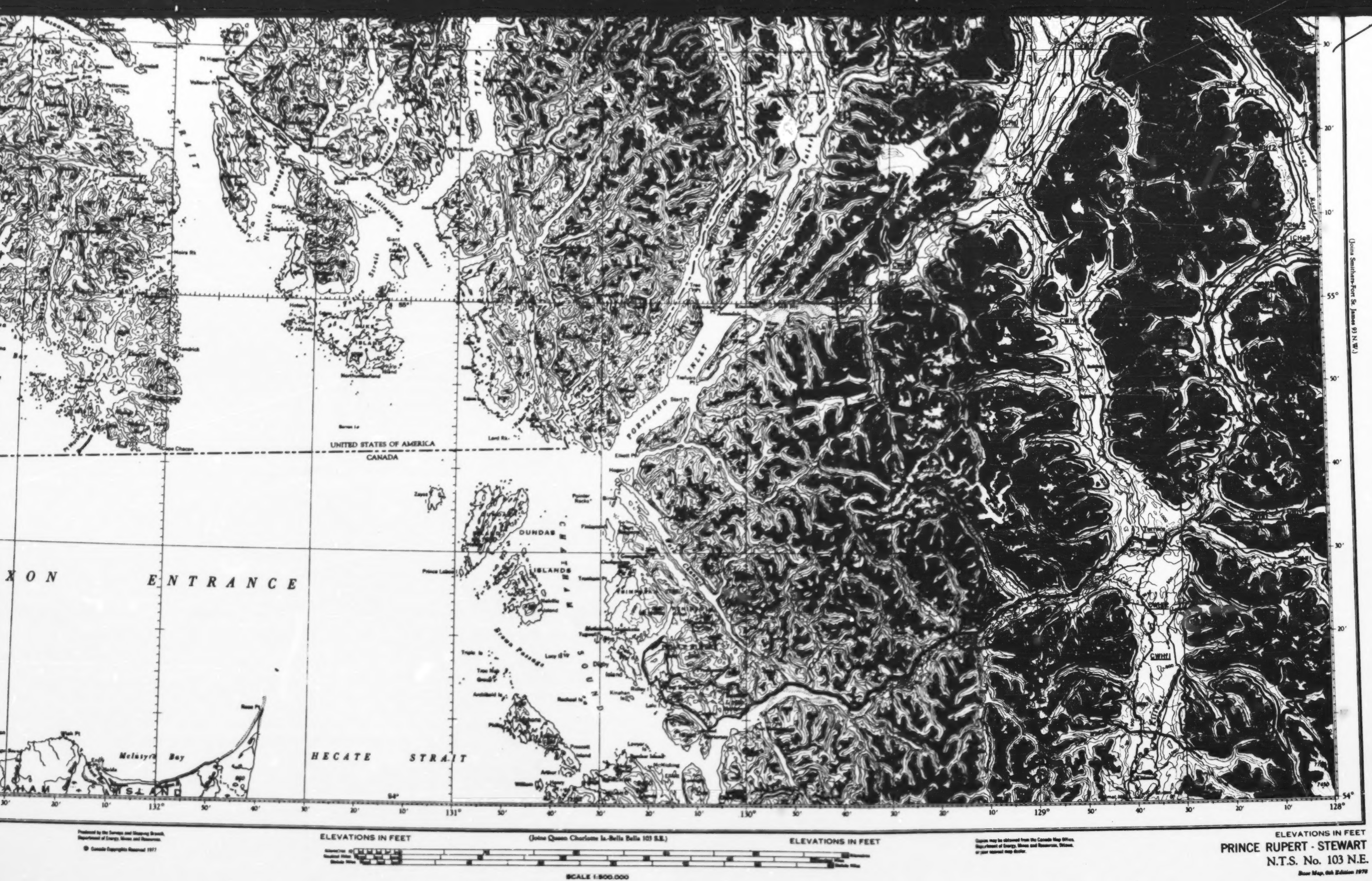
ELEVATIONS IN FEET

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ELEVATIONS IN FEET

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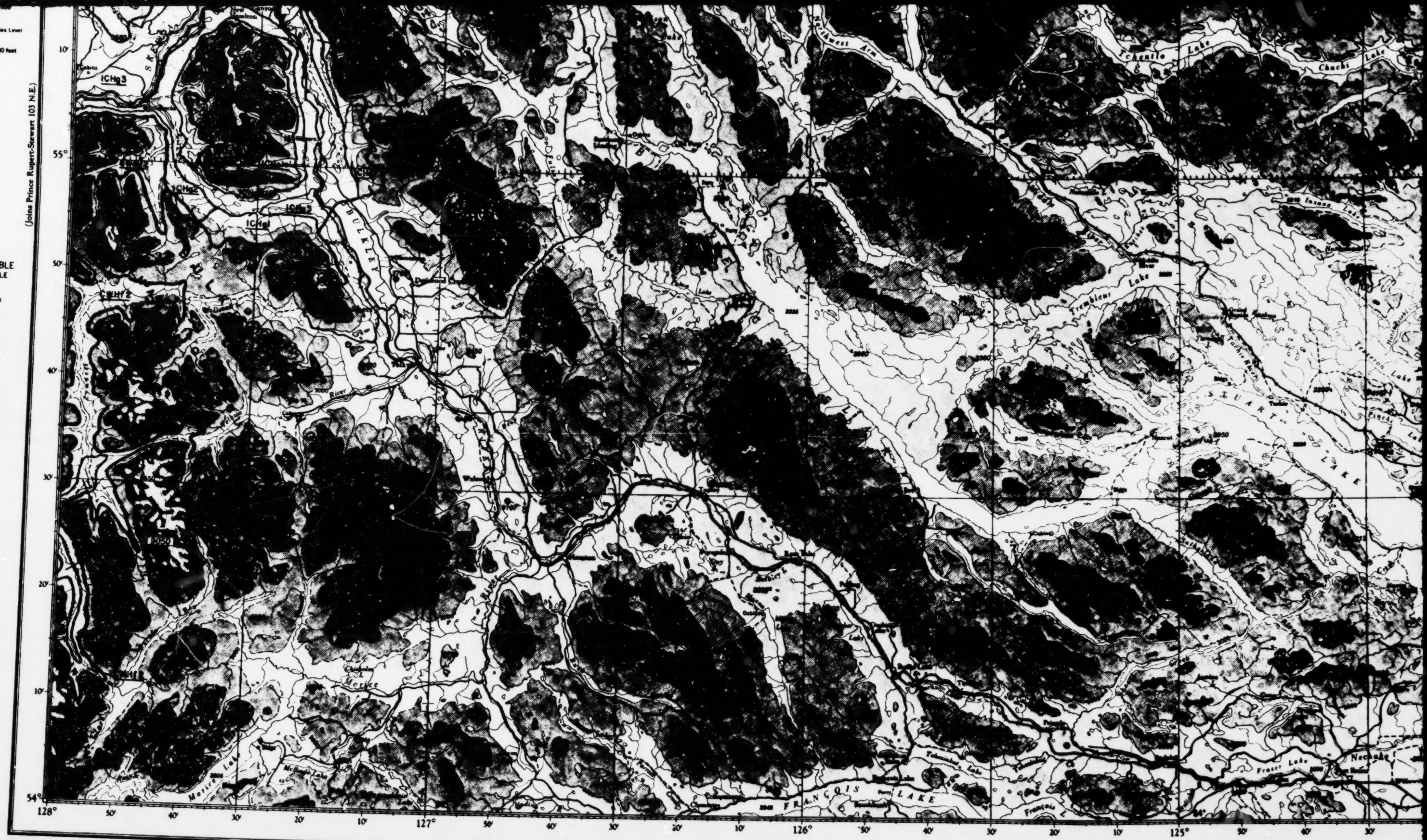
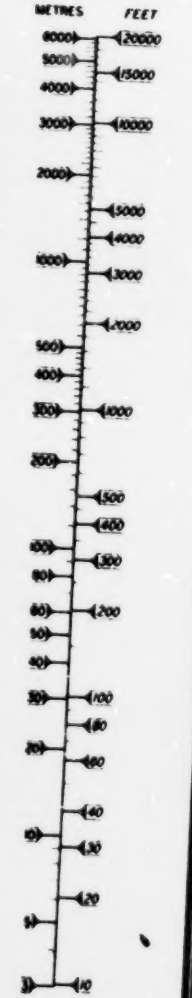
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Sea Level
Contour interval 1000 feet

(Joins Prince Rupert-Seawart 103 N.E.)

CONVERSION TABLE
LOGARITHMIC SCALE



ELEVATIONS IN FEET
Base Map, 5th Edition 1976

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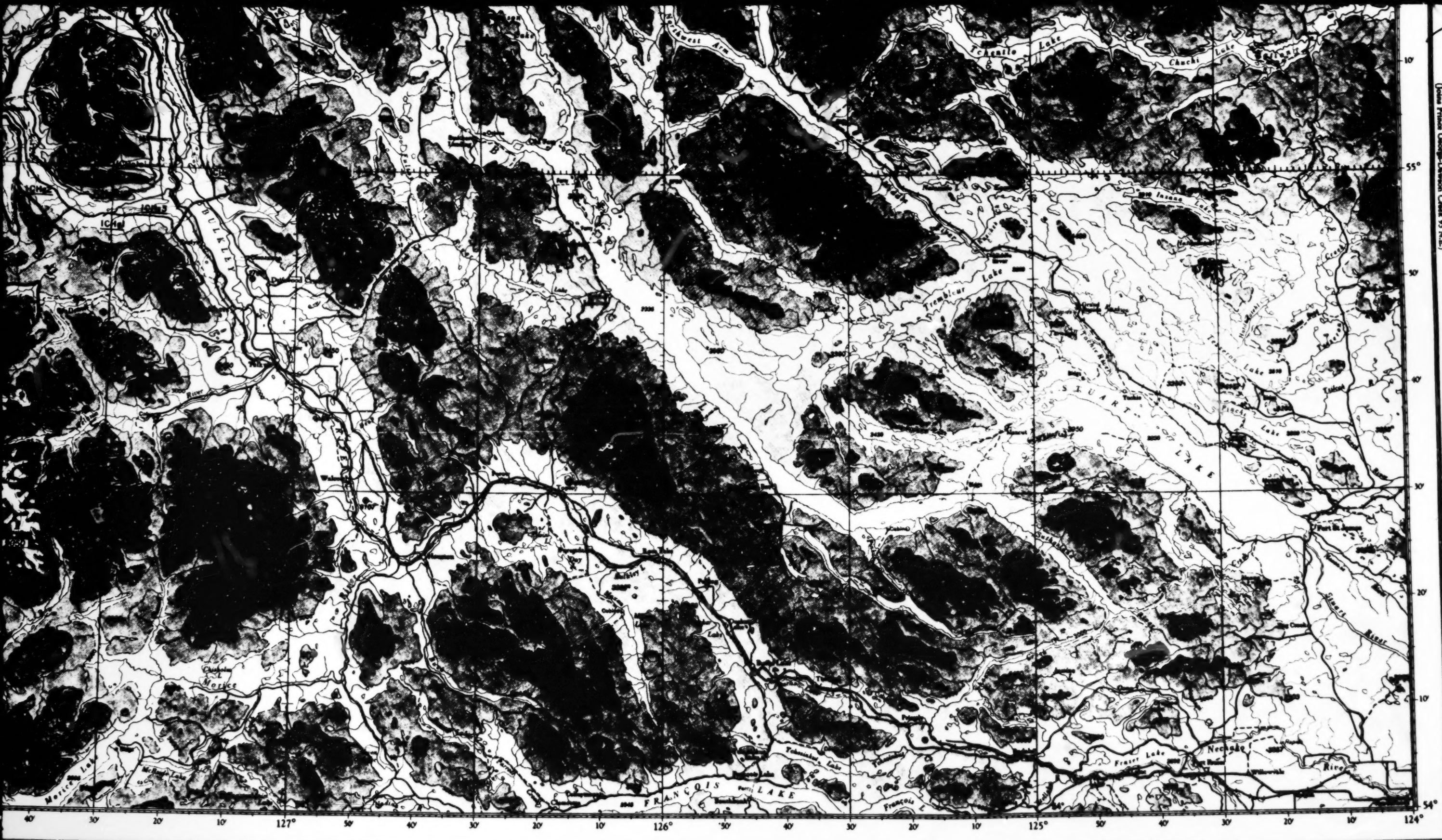
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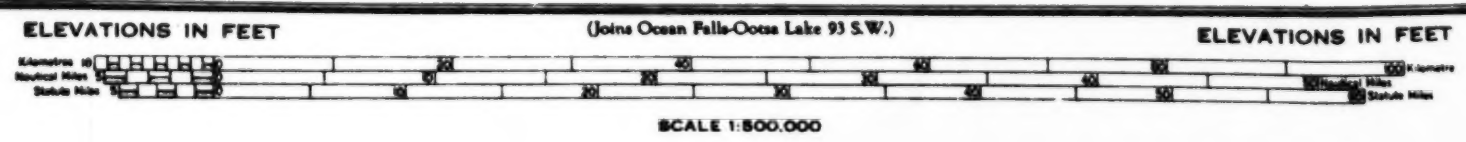
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